THURSDAY, AUGUST 10, 1893.

THE PROTECTION OF WOODLANDS.

The Protection of Woodlands. Authorised translation by John Nisbet, D.Œc., of the Indian Forest Service, of Kauschinger's "Waldschutz." Revised by Dr. Hermann Fürst. One volume, demy 8vo, 252 pages. (Edinburgh: David Douglas.)

FOREST Protection, termed *Waldschutz* or *Forstschutz* in German, is the art of protecting woodlands from external dangers, such as injurious meteoric influences, bad soils, injurious plants and animals, and human agency. The subject ranks in Germany as a separate branch of Forestry, distinct from silviculture, utilisation of forest produce, or forest management. In France, however, this is not yet the case; and the dangers to which forests are liable, together with the various preventive and remedial measures which experience suggests against them are described under the heads of forest botany, zoology, forest law, silviculture, and forest utilisation.

A strong reason for this difference of treatment of the same subject in the two countries is that the professors of subjects taught as auxiliary to Forestry at the French National Forest School at Nancy are experienced forest officers, but these subjects in Germany are taught by scientific specialists who have not sufficient forest experience to enable them to estimate the amount of damage likely to occur to forests from any form of injury, and the permissible limits of time and money in combating it. There is much to be said in favour of foresters studying botany and entomology from a general point of view and attending lectures on these subjects by eminent professors, instead of by foresters who may have worked up a branch of natural science more or less thoroughly, but it then becomes necessary that *Forest* Protection should be studied in a manual written by an experienced forester. The chief danger to the writer of a manual of forest protection is that he may be tempted to give undue preponderance to one branch of the subject, and in the work under notice the account of forest insects extends over 108 pages out of 246. This may be warrantable in Germany, where forest insects are unusually numerous and destructive, but in a treatise intended for practical use in the British Isles only confusion and bewilderment can result when insects which are destructive to forests in Central Europe, many of which do not exist here, while others that are rare and occur under different conditions, are described without any comment.

Mr. Nisbet has, in the section treating of forest offences, omitted certain matters relating only to German conditions of forestry. He should have carried his omissions further. No purpose is served by the inclusion of species such as *Chrysobothris affinis*, *Deudroctronus micans*, *Cnethocampa processionea*, &c., all unknown to the British forester, nor of varieties like *Tomicus sexdentatus*, *Lytta vesicatoria*, *Agelastica alni*, *Ocneria dispar* (apparently extinct), the Agrili, &c., unless the statements made are qualified by foot-notes, or otherwise. It is misleading to say that *Myelophilus minor*, whilst remaining unknown in many localities, often occurs in very large numbers in other places, whereas but a single British specimen is known; or that *Polyphylla fullo* occurs rather frequently here and there throughout sandy districts. A few species, though not British, like *Gastropacha pini*, or of rare occurrence, like *Tomicus typographus*, deserve notice in any boo dealing with forest entomology, provided that the freedom from them of our British woodlands is pointed out. This is done for the latter insect alone. If Mr. Nisbet had omitted about half the insects which he includes, he would have space to extend the diagnoses of the remaining species, which are too meagre to be of any use, and are little assisted by the roughly-coloured copies of some of the figures in Ratzeburg's "Forst Insecten." To give some account of insect attacks and methods of treatment in Britain, some species have been added, which, though rarely important, have occasionally annoyed tree-growers in this country, such as *Tomicus acuminatus*, *Earias chlorana*, *Pygaera bucephala*, *Sesia sphegiformis*, and particularly the wire-worms and millepedes often most destructive to seedlings. Many general statements appear which require modification, as, for instance, "in the *Diptera*, instead of any cocoon, a sort of bladder or shel is formed by the last larval skin"; and in the timber-boring *Scolytidæ*, "the larvæ hollow out short cone-like galleries at right angles to the main gallery," which is only true of *Trypodendron*, and not of *Xyleborus* or *Platypus*. Mr. Nisbet follows the German phraseology closely in his translation with curious results, such phrases as "raw localities," "ovi-depositor," "rostral beetle," seed owlet moths (*Agrotidæ:—Saat Eulen*) "multannual," are not welcome additions to the English language. One does not make "sections" of caterpillars to discover the presence of ichneumon larvæ; the Longicornia are not "cervicorn," but capricorn beetles; and the name Gold Beetle applied to *Clerus formicarius* is unintelligible.

The accounts of some of the more important insects, such as *Curculio abietis*, the cockchafer, and *Liparis monacha* (unimportant in Britain), are good, and the treatment recommended is in accordance with sound forestry; the section on decoy trees is one of the best, but if another edition is called for, the translator should submit the chapters dealing with forest insects to a competent entomologist and alter them so as to give a just account of forest entomology in Britain.

As regards the remaining parts of the book, in the account of the damage done by winds, "the system of cutting free or strengthening," *Loshieb* might have been rendered by the term *severance felling*, as proposed by Brandis in his notes on forest management in Germany published in 1888 by the India Office. Mr. Nisbet states that this system has not up to the present time enjoyed any very extensive adoption; but it is a fact that severance fellings are extremely common in the forests of Saxony. The term Scotch pine is surely preferable to that of Scots pine; and the English names of several birds on page 115 require revision. *Corvus frugilegus* is the rook and not the raven, and *Monedula turrium* is the jackdaw and not the rook.

The book is well printed and of useful size, being very similar in these respects to Dr. Schlich's manual of forestry, and apart from the chapter of forest insects, it will be very useful to the practical forester and to other

students of forestry. The annexed table of contents explains its general scope—

Section First. Protection of Woodlands against Injuries due to Inorganic Agencies.—Chap. I. Damage caused by unusually High or Low Temperature. (*a*) Frost. (*b*) Heat. II. Damage caused by Atmospheric Precipitations. (*a*) Rain. (*b*) Snow. (*c*) Hoar-frost, ice, hail. III. Damage caused by Aerial Currents. IV. Damage caused by Lightning. V. Disadvantages arising from Unfavourable Soil and Situation. (*a*) Excess of moisture; wetness. (*b*) Deficiency of moisture; dunes, sand-drifts. VI. Diseases of Timber Trees.

Section Second. Protection of Woodlands against Injuries due to Organic Agencies.—Chap. I. Damage caused by Plants. (*a*) Noxious forest weeds. (*b*) Parasitic plants. II. Damage caused by Animals. (*a*) Mammals. (*b*) Birds. (*c*) Insects. (*a*) On coniferous trees principally. (*b*) On broad-leaved trees principally.

Section Third. Protection of Woodlands against Human Agencies.—Chap. I. Protection of Forest Boundaries. II. Protection against Misuse of Rights or Servitudes. III. Protection against Forest Offences and Misdemeanours. IV. Protection against Forest Fires. V. Protection against Damage by Smoke and other Atmospheric Impurities.

NORTH AMERICAN BUTTERFLIES.

Brief Guide to the Common Butterflies of the United States and Canada. Being an Introduction to the Knowledge of their Life-histories. By Samuel Hubbard Scudder. (New York: Henry Holt and Co., 1893.)

The Life of a Butterfly. A Chapter of Natural History for the General Reader. (Same author and publisher.)

IN the two small volumes before us Dr. Scudder, the author of the greatest monograph on any limited butterfly-fauna that has yet appeared ("The Butterflies of the United States and Canada"), has attempted the no less useful task of popularising the subject for the less advanced student.

Far more attention is paid in America than in Europe to the life-histories of insects, and the plan of Dr. Scudder's "Guide" is sufficiently indicated by the author in his preface. "I have accordingly selected the butterflies—less than a hundred of them—which would almost surely be met with by any industrious collector in the course of one or two years' work in the more populous Northern States and Canada . . . . As the earlier stages of these insects are just as varied, as interesting, and as important as the perfect stage, descriptions are given of these . . . . only such stages as would be more commonly met with being fully described, and the egg and earliest forms of caterpillar omitted as rarities, and also as too difficult for the beginner's study."

Those who know the thorough character of Dr. Scudder's work will not be surprised to learn that even within the narrow limits laid down, the book contains a far larger amount of general information than would be found in almost any popular European manual on a similar subject. Not that such information respecting our European butterflies does not exist, but it is scattered through thousands of volumes of periodical literature, and has hardly yet been properly systematised for the advanced student, much less for the beginner.

The introductory portion of Dr. Scudder's work consists of general information respecting butterflies in their various stages, separate keys to the American genera, both for the perfect insect and for the caterpillar and chrysalis, an explanation of neuration with a diagram, &c., &c.

In the body of the work each species occupies from one to two pages. It is first described as butterfly, caterpillar, and chrysalis, and then a full account of its life-history, habits, localities, times of appearance, &c., in all its stages, from egg-laying onwards, is given in larger type. An appendix contains instructions for collecting, rearing, preserving, and stuffing, extracted from one of Dr. Scudder's former works.

Dr. Scudder is rarely to be found tripping, but we think that the section on the senses of insects is hardly abreast of our present knowledge of the subject. On p. 23 he says, "The sounds made by butterflies are apparently due simply to the rustling of the wings." If he will refer to the work of an eccentric writer, but a good observer (Mr. Swinton's "Insect Variety," pp. 112–127), he will find a good deal of information about the stridulation of butterflies.

The second work which we have to notice, though smaller, is perhaps of greater interest to the European entomologist. It deals with *Anosia Plexippus*, the Monarch or Milk-weed Butterfly, one of the largest and most abundant of North American butterflies, a migratory insect which is rapidly extending its range over the warmer parts of the world.

It has been selected as a butterfly whose life-history presents more interesting points than that of most others (though other butterflies are, of course, referred to in the course of the work), and the following are some of the principal points which Dr. Scudder discusses in reference to it: the tongue, course of life, vagrancy, critical periods, mimicry, scent-scales, insect-vision, the fore-legs, the position of the chrysalis, the proper name, &c.

It is now pretty well ascertained that this butterfly has as regular an annual migration as birds in North America from south to north and north to south. No lepidopterous insect probably possesses the habit to anything like the same extent; for the migrations of the day-flying moths of the genus *Urania*, though regular, are confined to comparatively narrow limits in the tropics.

We will now notice a few points that have struck us in glancing through the book. At p. 64, Dr. Scudder says: "There were certainly no butterflies here when the country was flooded with ice." Is not this too sweeping a statement? Have not our Arctic explorers found butterflies as far north as they have yet succeeded in penetrating?

It is pretty well known that newly-hatched caterpillars generally devour the shell from which they have just emerged. This has usually been regarded as merely an odd habit; but Dr. Scudder suggests that its real object may be to avoid betraying the proximity of the larva to its enemies by leaving the empty eggshell as an indication of its presence (p. 70). Scent is considered by Dr. Scudder

to play an extremely important part in butterfly life. There are, of course, great differences in the structure of the eyes of different insects, but there is reason to believe that it is often very defective, and that its imperfect character is supplemented by a highly delicate sense of smell. A curious account of wasps chasing flies is given at p. 122, which seems to show that wasps at least are not the highly-endowed and intelligent creatures which some have been disposed to imagine. Yet the sense of smell in insects may be mistaken, as witness the well-known fact (which Dr. Scudder has forgotten to mention) that carrion-feeding flies will sometimes lay their eggs on foul-smelling plants. He finally sums up his remarks on the senses of butterflies as follows:—"It becomes clear that the exquisite beauty and variety in the butterfly world is not recognised by themselves, and form no element in their lives."

While agreeing with Dr. Scudder in the main as to his remarks on nomenclature, we are not quite sure that he is correct in applying Linné's name *Plexippus* to the butterfly in question. It is certain that Linné confounded two or three species under the name, among which was the Milk-weed Butterfly, and gave the locality as North America; but the words "Alæ primores fasciâ albâ, ut in seq. (*Chrysippus*) cui similis," seem to us to indicate that the name would be more correctly applied to an East Indian species; for no American species of the group agrees with the characters which we have quoted.

In reference to what Dr. Scudder says on p. 178 respecting the origin of the Pacific immigrants, we may mention that, to the best of our recollection, all the specimens of the butterfly which we have seen from any part of the Old World belong to the normal type of the United States.

The book is illustrated with four plain plates, representing the insect in its various stages, and numerous details.

In America, at least, entomologists are fast outgrowing the time when nothing was thought worthy of attention but the perfect insect. We imagine that the time is not far distant when no account of an insect will be regarded as *complete* which does not include its external and internal anatomy in all its stages as well as its life-history. W. F. KIRBY.

OUR BOOK SHELF.

Life with Trans-Siberian Savages. By E. Douglas Howard, M.A. (London: Longmans, Green, and Co., 1893.)

AWAY beyond Siberia proper, in the Okotsk Sea, lies the island of Saghalien, or Sakhalin. Acquired by Russia many years ago, it has been converted into a vast prison, in which to confine convicts, for whom transportation to the mines of Siberia is considered insufficient. To this island, even the name of which is whispered in fear in Russia, Mr. Howard was fortunate enough to gain access. Walking through the exile hospital one day, he saw a being unlike any he had met before, and which, it was afterwards explained to him, was a female of the race of Sakhalin Ainus—the aborigines of the island, and the progenitors of the Ainus of Japan. Mr. Howard was naturally fired with the desire to see more of the race, which possesses the distinction of being as simple in their savagery to-day as they were three thousand years ago. The book before us tells the tale of his journey to the Ainu country and his life among the people. The story is full of interest, and is told in an unaffected manner, without any straining after effect. As an example of the author's style the following account of the aboriginal method of procuring a light will suffice:—

"A rough little apparatus was produced, consisting of two little blocks of wood. Between these was placed a bit of very dry elm stick, one end, which we will call the lower end, being pointed so as to fit loosely into a hole in the lower block; the other end, also pointed, being in contact only with the flat under surface of the upper block. A bow was then unstrung at one end, the string was passed round the middle of the dry stick, and the free end was loosely re-attached. The bow was then worked with wonderful celerity, until the lower end of the stick first smoked, and then passed into a fitful blaze. This was communicated to some fine dry twigs, and in a few minutes we had as good a bivouac fire as I could wish."

Mr. Howard witnessed the manufacture of the poison used by the Ainu for tipping arrow-heads. His description brings to mind the witches' caldron in *Macbeth*. An infusion produced from dead spiders was mixed with inspissated gall of foxes, and a thick extract of the roots of *Aconitum napellus*, in order to procure the deadly paste. It has been said that the Ainus of Japan perform no religious ceremonies during the preparation of these ingredients, but Mr. Howard's observations show that the Ainus of Sakhalin certainly do sanctify them. After preparation the paste is pressed into a long and deep hollow in the arrow-head, and its poisonous properties are preserved by smearing the head with a resinous gum. The secret of manufacture is only known to the two chiefs of the village and two arrow artificers.

There are many other points of interest in Mr. Howard's narrative, especially to the student of ethnology. In fact the book appears to be a "plain, unvarnished tale" of personal observations, and on this account, if for no other reason, it is well worth reading.

Advanced Physiography. By R. A. Gregory and J. C. Christie. (London: Joseph Hughes and Co., 1893.)

TEACHERS have long felt the need of a good text-book on advanced physiography, and will no doubt fully appreciate the little book before us. Mr. Gregory's twelve chapters on the astronomical side of the subject form an admirable supplement to his now well-known "Elementary Physiography." This part of the book is treated in a very practical manner, and the text is at the same time remarkably free from errors; one mistake, however, is in placing β Cassiopeiæ amongst the bright-line stars instead of γ Cassiopeiæ. The various astronomical instruments are described in a clearly-written and well-illustrated chapter, which should prove extremely useful to students who have not the advantage of seeing and using the instruments for themselves. In all the most recent discoveries the book is well up to date; in the chapter on "Stars and Nebulæ" a racy account is given of the discovery, observations, and probable origin of the new star in Auriga. The author writes with a practical knowledge of his subject, and has done as much justice to it as the limitations of a text-book allow.

Mr. Christie is responsible for the three final chapters, dealing with the earth as a cooling globe in relation to Kant's hypothesis. The treatment adopted is more of the nature of an essay than that of a text-book; but, as pointed out by the author, this is chiefly due to the fact that the subject is to a great extent speculative. The table of the terrestrial elements known to occur in meteorites and other celestial bodies might have been of value if sufficient care had been taken to insure accuracy. As regards the elements in the sun it differs very widely

from the table given by Mr. Gregory on p. 185, and several elements, such as bromine, are erroneously included.

The 107 illustrations form a noticeable feature of the book, many of them having been specially drawn for it. We confidently recommend the book to the notice of teachers, for it is certainly one of the most excellent expositions of the subject that we have yet seen.

Proceedings of the Edinburgh Mathematical Society. Vol. xi. (London: Williams and Norgate, 1893.)

THE practice recently adopted by this Society of issuing its volumes in complete form at the end of its session, whilst it has some advantages, has the great disadvantage which results to an author in the long delay of the publication of his results if he has made his communication early in the session. We believe, however, that the Society meets this objection by allowing authors to have copies of their papers as soon as they are printed.

There are twelve contributors to this volume of 170 pages. The historical notes are especially interesting. They are on the history of the Fourier series, by G. A. Gibson; history of the nine-point circle, early history of the symmedian point, and Adams's hexagons and circles, by Dr. J. S. Mackay. These last are written in Dr. Mackay's usual interesting style, with full references to early writings on the several points. It is a pity that he has not received sufficient encouragement to publish his large store of notes in a single volume instead of issuing them in the shape of detached notes. Prof. A. H. Anglin gives a paper on certain results involving areal and trilinear coordinates. Mr. C. Chree writes on action at a distance, and the transmission of stress by isotropic elastic solid media, and Mr. W. Peddie contributes notes on the use of dimensional equations in physics, on the fundamental principles of quaternions and other vector analyses, and on the elements of quaternions. This last subject is discussed at some length by Prof. Knott in the quaternion and its depreciators. His attitude is well known to the mathematical readers of NATURE (see vols. for 1891-2-3). The remaining notes appeal to the mathematical masters, who form the major part of the *clientèle* of 131 members.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Publication of Scientific Papers.

THE discussion of this important subject has been started *à propos* of physical papers, but the publication of papers in all branches of science is in an equally unsatisfactory state.

Prof. Lodge, in his letter in your issue of July 27, after paying attention to the preparation of useful abstracts of all papers on physical subjects appearing both at home and abroad, calls attention to what has always appeared to me to be the most important matter for reform, namely, the means and methods of publication of English scientific papers.

There is no complaint more frequently heard abroad than that important papers of English scientific men are almost inaccessible to the foreigner, because it has been the fashion to communicate them to local societies and to rest content with such publication as is secured by their being printed in the Society's Proceedings or Transactions. If these societies distributed their publications liberally where there are students who ought to have the opportunity of reading them, and without taking account of whether they receive in exchange a publication of an equal number of pages, the evil would be much less. But this is not so. It is notorious—to take, for instance, the Royal Society of Edinburgh, with which I am best acquainted, and which is not by any means the least liberal in the matter of distribution—that unless the author distributes lavishly separate copies of his paper in every quarter where he considers it important that it should be read, it will pass unnoticed, and a worker in the same branch of science will not consider that he is open to any blame for not being acquainted with a paper published in an organ so difficult to procure. I believe that this applies in at least an equal degree to the other two societies mentioned by Prof. Lodge, namely, those of Dublin and Cambridge, and of course it is all the more applicable to societies of less importance. But even the Royal Society itself is open to exception in this respect, for although no fault can be found with the Proceedings or Transactions as a recognised organ of publication, they are, as a matter of fact, not more readily accessible abroad than the corresponding publications of the Edinburgh Society, and the majority of foreign students never see anything but abstracts of important English papers. The only independent scientific journal of importance is the *Philosophical Magazine*, and though widely known it is not extensively used, and has not grown with the times. The want of means of scientific publication which has been produced by the development of scientific activity in the last twenty or thirty years has been met by an increase in the number of societies, and by a greater development of society publication. The former is probably an advantage, the latter is certainly a disadvantage. The publication of scientific papers cannot be too much centralised in the interests of both authors and readers, and for this purpose a central organ such as indicated by Prof. Lodge is required.

What is at present inefficiently and extravagantly done by a multitude of amateur publishers scattered over the country could at much less cost be efficiently done by a central publishing officer issuing a central organ, in several series, each series appearing in monthly numbers, and the whole run on strictly business lines. Each series should be devoted to a particular science or branch of a science. Thus, there might be several series in chemistry as organic chemistry, inorganic chemistry, physical chemistry and technical chemistry. Physics also would fall into several series, as would other sciences. Each series of original papers would have a parallel one of abstracts of foreign papers on the same subject, and it would be useful to have a separate series, which might be issued weekly or fortnightly, devoted to printing a minute of the proceedings and papers read at the meetings of the various societies throughout the country, to be furnished by their secretaries.

The effect of the realisation of some such plan as this would be the immediate setting free of the large sum of money annually spent by the societies in printing, and the collection of all that is published in *one* organ, which would be an enormous assistance to the student.

Each series would have to be intelligently and liberally indexed, and a separate volume of the indices of all the series published each year. It would then be sufficient for the worker to take in the series devoted to his own branch of science and the yearly index volume, which would prevent his overlooking papers of importance appearing in other series.

This scheme of central publication has occupied my thoughts for some years, and I have from time to time discussed it with my friends, and it has even been brought before one publisher, but without any practical effect.

It is therefore with very great pleasure that I find Prof. Lodge advocating a similar scheme, and I hope that it may be the means of fixing public attention on the present unsatisfactory state of things and of forcing a remedy.

August 8. J. Y. BUCHANAN.

THE abstracts of physical science for the year 1886, published by the Berlin Physical Society, are contained in three stout octavo volumes, comprising over 2000 pages, while the somewhat less comprehensive supplements to the *Annalen* average about 1000 pages. A good index, on the other hand, can be prepared at little more than the cost of printing. An index entry, which contains the full title of the article, the name of the author, the correct reference, the number of pages covered by the article, and, where necessary, a brief indication of the scope of the article, is sufficient to inform the student where each advance in his particular branch of science is to be found reported, and is of permanent value to searchers of all sorts, provided a proper system of classification of the index entries is adhered to. The scheme of indexing carried out by the Association of Engineering Societies of America presents many features worthy of imitation. The index, which appears monthly in the journal, is printed on one side only (the reverse

is available for advertisements) and possesses a separate pagination, so that a student can extract for himself any entries which he may require. At the end of the year the index is consolidated, so as to form a permanent record of the progress of the science during that period. The consolidation of the index can be cheaply effected by an arrangement with the printer to keep the type standing for twelve months, when, in addition to the reference to the source of the original paper, references to abstracts and reviews can be incorporated. If the Physical Society would undertake such a work, it is probable that the utility of the index would lead to an extension of the system to other sciences also. It is clear that by a cooperative arrangement between two or more societies various indexes could be issued at a relatively slightly increased cost. The economy is obvious: the same files have to be searched but once, the same staff would be competent to do the combined work at a cheaper rate, and minor economics could be effected in stationary salary of editor, &c.

It remains to be seen whether English physicists are disposed to abandon their present attitude of masterly inactivity—waiting until, in the fulness of time, International Bureaus shall step in and do the work for them. A simple scheme like the above requires no *deus ex machinâ* in the shape of British Association aid to set the ball rolling.

E. WYNDHAM HULME.

44, Blenheim Terrace, N.W., July 31.

The General Motions of the Atmosphere.

TWO cyclonic storms have occurred over the Indian region, the tracks of which appeared to be suggestive of the existence of very abnormal conditions in the general circulation of the currents of the atmosphere. The first storm appeared over the east of the Bay of Bengal, in about lat. 15° N., on May 20. The centre crossed the bay on a W.N.W. track during the 21st and 22nd, and appeared on the Orissa coast on the 23rd. Here it slowly recurved and followed a N., N.E., and E. course, finally passing away on May 29 or 30 into Assam and Manipur. The second storm appeared over the east of the bay, also in about lat. 15° N., on June 11, passed during the 12th, 13th, 14th, 15th, and 16th W.N.Westward across the bay, and to the centre of the Indian Peninsula. It there recurved, like its predecessor, through N. and N.E., and finally into E.

Combining the direction of movement of the two storms for each twenty-four hours after movement commenced we obtain the following figures:—

	Direction.		Direction.
1st day,	N. 80° W.	6th day,	N.
2nd ,,	N. 78° W.	7th ,,	N. 27° E.
3rd ,,	N. 52° W.	8th ,,	N. 50° E.
4th ,,	N. 36° W.	9th ,,	N. 70° E.
5th ,,	N. 13° W.		

The following is the normal movement of storms during the period May 20 and June 20, extracted from the "Handbook of Cyclonic Storms in the Bay of Bengal," by combining the directions of motion of each storm recorded within the period:—

	Direction.		Direction.
1st day,	N. 48° W.	5th day,	N. 48° W.
2nd ,,	N. 39° W.	6th ,,	N. 41° W.
3rd ,,	N. 40° W.	7th ,,	N. 22° W.
4th ,,	N. 55° W.		

It will be observed from this comparison that the direction of movement of the two storms of May–June, 1893, disagrees with the average movement of storms at this time of year. On the other hand, "recurving" from a N.W. translation, through a N. translation into a N.E. and E. translation is in the Indian region a marked feature of the progressive motion of storms in the spring and autumn months, and it hence follows that if the direction of movement of cyclones is controlled by the upper currents of the atmosphere, then the upper currents existing over the Indian region at the end of May and during the first half of June in the present year were analogous to those ordinarily prevailing over that region in the spring and autumn, and were not comparable with those normally prevailing at or about midsummer. Now, according to an hypothesis put forward by the writer, there exists over this thermal equator a current of westerly translation, and it is within this current, or on the margins thereof, that all the more important cyclones originate. On the north side of the current of westerly translation air currents exist, moving first to N.W., then to N., and finally towards N.E. and E., transferring the air raised over equatorial regions (or rather over the regions covered by the thermal equator) towards the temperate zone. In ordinary years nearly all the storms of the bay appearing between May 20 and June 20 appear to the north of lat. 18°, and the great majority of them to the north of lat. 20° N. At the same time the thermal equator and air-current of westerly translation at midsummer covers northern India, and its northern margin lies close to the Himalayan range of mountains. This range obstructs any northerly movement of cyclones, and hence the direction of motion of storms is controlled by the current of westerly translation, and is towards the west. In the spring and autumn, on the contrary, the thermal equator lies over southern India, and the motion of cyclones is—first westerly, within the equatorial current of westerly translation, and subsequently along the curved track described by the returning air. When, then, as in the present case, we have occurring nearly at midsummer a direction of movement of cyclones analogous to that prevailing in the spring and autumn, it may not be unfair to assume that the thermal equator, the return current of air from the torrid to the temperate zone and the massive current of easterly translation over the temperate zone, all lie to the southward of the positions occupied by them in normal years. If this be the case in the Indian region, it is conceivable that similarly anomalous conditions prevail in other parts of the world; and it is, perhaps, possible that the exceptional weather which has prevailed over the United Kingdom, and other portions of the north temperate zone, may be due to the fact that the United Kingdom, &c., relatively to that portion of the current of easterly translation which ordinarily transports cyclones eastward has been modified, and that this portion of the current, and consequently the path of cyclones, lie to the southward of their normal positions.

It is very difficult in India to accurately determine the lie of the thermal equator, as it is very doubtful if temperature observations at the earth's surface are in themselves sufficient to show the real atmospheric thermal conditions. Apparently, however, the centre of the thermal equator in May runs from about lat. 18° to 20° N. in long. 96° E. to lat. 25° N. in long. 68° E. The writer has extracted from the monthly weather review the temperature (day temperature) anomalies of three stations (Calcutta, Allahabad, and Lahore) lying to the north and of three stations (Nagpur, Madras, and Bombay) lying to the south of the line given above, and finds they are as follows:—

$$\text{Northern Stations.} \left\{ \begin{array}{ll} \text{Calcutta} & = -4^\circ\cdot2 \\ \text{Allahabad} & = -3^\circ\cdot0 \\ \text{Lahore} & = -1^\circ\cdot9 \end{array} \right\} = -3^\circ\cdot1$$

$$\text{Southern Stations.} \left\{ \begin{array}{ll} \text{Nagpur} & = -2^\circ\cdot4 \\ \text{Madras} & = +1^\circ\cdot3 \\ \text{Bombay} & = -0^\circ\cdot8 \end{array} \right\} = -0^\circ\cdot6$$

These observations show negative anomalies for both regions but they would also appear to show, from the largeness of the anomaly to the north and the smallness of the anomaly to the south, that the line of greatest heat over India in May had been thrown to the southward. According to the writer's views, however, the low latitude of the place of origin of the cyclones and the subsequent curved trajectories of the storms are stronger evidences of the southerly position of the tropical band of westerly translation than that afforded by temperature observations taken at the earth's surface. W. L. DALLAS.

Simla, India, July 2.

Thunderbolt in Warwickshire.

ON Sunday evening, July 2, this part of Warwickshire was visited by a very severe storm of thunder and lightning, accompanied by torrents of rain. After the storm had subsided, about ten minutes before ten o'clock in the evening, a fireball seems to have fallen in the village of Dunchurch, an occurrence still rare enough to warrant its being placed on record.

On the afternoon of July 4 I visited the garden of A. H. Harrison, Esq., of Dunchurch Hall, in which an explosion occurred at the time indicated, breaking off at about seventeen feet from the ground a fine specimen of Wellingtonia growing on

the lawn, which had been when intact about thirty feet high. The upper portion was shivered, fragments being scattered far and wide both over the lawn and an adjoining field, some fragments sticking in the grass lawn and showing that they must have been hurled with great force.

At the same time twenty-four panes of glass in front of the house were smashed by the violence of the explosion, at a distance from the tree of twenty-three to forty-three yards.

It was noticed that windows of plate glass, as well as windows which happened to be open at the time, escaped. The explosion is said to have been quite unlike thunder, and to have resembled the report of a heavy piece of ordnance. It is probable that the report was heard here in Rugby, as I find that two persons who happened to be in my house at the time remember hearing a double report at about the same hour, which they remarked upon to each other as being like the distant firing of a cannon.

As to the evidence of the agent of destruction being a fireball, I have, through the kind help of Mr. Harrison, been enabled to examine four witnesses, all of whom agree that during an interval of two minutes before the explosion a large fiery globe was seen travelling through the air, and emitting light of such dazzling brilliancy that the only one of them who was out of doors at the time was for a moment blinded and dazed, and felt for some short time afterwards a sensation of pain in the back of the head and the neck.

A fifth witness, whom I did not see, was at the time of the explosion in a room overlooking the lawn on which the tree grew, and states that she saw through the drawn blind the reflection of a fiery round ball at the instant of explosion.

The ball seems to have been larger than any hitherto observed, all speaking of it as appearing larger than the sun or moon, and one of them said it was as large as an ordinary fire-balloon when seen at a short distance. The colour is said to have been of an intense fiery red, but a person who did not see the ball was startled almost at the instant of the explosion by the lighting up of a long passage in Dunchurch Hall by an intense blue light.

The path taken by the fireball during the two minutes it was observed could hardly have been direct, as the direction taken when first seen makes an obtuse angle with the direction indicated by all who saw it immediately before the explosion.

14 Bilton Road, Rugby. L. CUMMING.

P.S.—I have submitted a draft of this letter to Mr. Harrison, who agrees with me in the accuracy of the report given above.

The Suicide of Rattlesnakes.

I NOTICE in NATURE for June 1, 1893, page 107, an inquiry by Mr. R. I. Pocock as to the suicidal habits of scorpions. His conclusion is that if scorpions sometimes kill themselves, the verdict must be "accidental suicide, or suicide while of unsound mind." I have no evidence to offer as to the habits of Californian scorpions, but I have myself witnessed the deliberate suicide of a rattlesnake, and think that a brief account of it may be worth recording. In the summer of 1888 Prof. Keeler saw a large rattlesnake (with seven rattles) crawl under the foundation of the dome of the six-inch equatorial. With the nice manipulation for which he is famous, Dr. Keeler fastened a pair of blacksmith's tongs about the animal's neck, and brought him into the large marble vestibule of the observatory. The snake was furious and was practically uninjured. After every one had seen him it became a question what to do next. It was resolved to put him into a gallon jar of water. Dr. Keeler had the task of getting the very lively animal (which was some three feet long) into the jar, and of letting go with the tongs; while I undertook to put in the stopper of the bottle at an auspicious moment. All this was accomplished very nicely, and the next step was to drown the snake by inverting the jar at intervals. After a little time it became obvious to every one, the snake included, that the animal must soon be drowned. At this moment the snake ceased any attempt to rise to the surface of the water in the jar, and in the most deliberate manner struck its fangs deep into its body. I have no doubt whatever that the blow was intentional, and with suicidal purpose. It was a single deliberate blow. There was no flurry. As far as one could see the animal was of sound and disposing mind and memory. It had been full of fury at first, but latterly had only sought to escape from the water to the air at the top. When this became hopeless the snake ended its own struggles. I had often heard that snakes (and scorpions) put an end to their own lives. Here is an instance which occurred before my eyes. The snake is now preserved in alcohol at the observatory, and the marks of the fangs are plainly to be seen.

Lick Observatory, July 19. EDWARD S. HOLDEN.

New Conclusions.

IN the last volume of the Proceedings of the Royal Society of Victoria, a paper appears by us entitled "Preliminary Account of the Glacial Deposits of Bacchus Marsh." In this paper we claimed to have shown that there were two distinct deposits of till separated by sandstones assigned to the Triassic age, and moreover that the upper till rested on the denuded surface of the latter.

Further examination has shown that we were mistaken as regards the last point. Our conclusion had been drawn mainly from a section which we have described and figured as occurring at a small quarry on the Korkuperrimul Creek. At this place we described till as overlying, and a granite boulder over a yard in diameter, together with smaller boulders, as being jammed into, the broken surface of the sandstone.

The real state of things is that the clay material containing the boulders is really a bed intercalated with the sandstone, the whole being inclined at about 35°–40°. What was described as till overlying these sandstones turns out to be a "wash" containing striated stones, and derived from an outcrop of a till-like deposit a little above. Besides the larger clay bed containing the large boulders, there are several other thin bands of clay intercalated with the sandstone containing pebbles, several of which we found to be striated.

The real succession in this locality would now appear to be as follows:—

(1) Till, undoubtedly morainic, and probably resting on silurian rocks.
(2) Shales.
(3) Massive sandstones with intercalated bands of clay bearing transported boulders.
(4) A till-like deposit containing boulders.
(5) Shales and well-stratified fine argillaceous sandstones.

It would be unwise to assume that this succession represents the general order in Victoria, as stratified deposits associated with till may be of local significance only.

As the fossil evidence so far obtained points to the sandstone being of fresh-water origin, it seems reasonable to suppose that it was deposited in a glacial lake into which sub-glacial streams flowed, and in which floating ice wandered, dropping boulders here and there. At the quarry above-mentioned, the clay bed containing the large boulders, and the sandstone adjacent to it, are remarkably contorted as if an iceberg had grounded there.

As to the real nature of the till-like deposit referred to as overlying the sandstone, we do not yet care to speak definitely. It presents some strong points of resemblance to true till, but it may be of aqueous origin aided by floating ice.

It will be now seen that the sandstones known as the Bacchus Marsh Sandstones must be considered as part of the glacial series. Our friend Mr. Charles Brittlebank has also come to this conclusion quite independently of us. Of course the other sections given with our paper will have to be altered in accordance with the foregoing.

Having recently had an opportunity of seeing the glacial deposits near Heathcote, described by Mr. Dunn last year, we may say that there, as at Bacchus Marsh, the lowest member, at least, is a true till due to the action of land-ice. We cannot agree with Mr. Dunn in his opinion that these deposits are entirely an iceberg drift.

A notable point of difference between the till at Bacchus Marsh and that at Heathcote, lies in the immense quantity and variety as well as the great size of the rock-debris in the latter locality. Mr. Dunn well expresses it when he says that it looks as if the ruins of a continent were gathered here. It would almost seem as if Heathcote were in the region of a terminal moraine. The somewhat unsatisfactory evidence afforded by the "roche moutonnée," known as Dunn's rock, seems to indicate that the ice came from the south in this district.

GRAHAM OFFICER.
Melbourne University, July 4. LEWIS BALFOUR.

THE THIEVING OF ASSYRIAN ANTIQUITIES.

SO much interest is now taken in the archæological researches made in Egypt and Assyria that it behoves a journal of science to chronicle a case of considerable importance that has recently been before the law-courts. The case is noteworthy, because it is concerned with the excavation and disposal of the wonderful tablets, the decipherment of which has added so much to our knowledge of the early history of mankind.

We have not referred to the case earlier, as we had hoped that some action in the public interest would have been taken by the Trustees of the British Museum, which would have carried the matter a stage further. For this action however we have waited in vain.

Although the real question at issue is the spending of many thousands of public money, the case in the newspapers has taken the form of an action for libel. The plaintiff in the case was Mr. H. Rassam, formerly assistant-excavator to Sir Henry Layard in the works carried on for the trustees of the British Museum on the sites of the ancient cities of Nineveh and Calah in Assyria. His action was against Dr. Wallis Budge, acting Assistant-Keeper in the Department of Egyptian and Assyrian Antiquities in the British Museum. It was alleged that Dr. Budge had made certain reports concerning the way in which Mr. Rassam had disposed of some of the excavated antiquities, and that these statements were made to Sir H. Layard both at the British Museum and elsewhere. The statements were said to imply that Mr. Rassam had connived at depredations on the sites of the excavations made by him in Babylonia during the years 1876-82 for the trustees of the British Museum. Mr. Rassam estimated that his reputation had suffered by these charges to the extent of £1000, and after a hearing of four and a half days the jury decided in his favour, though there was a difference of opinion among them as to whether Dr. Budge's statements were actuated by *malice prepense*, and awarded him £50 to make up for the loss sustained by the defamations and to soothe his virtuous indignation. Such was the case before the public; the public interests behind it may be gathered from the following statement.

It will be remembered that so far back as 1846 Mr. Layard began to excavate at Kouyunjik for the trustees of the British Museum. These excavations had, we understand, been commenced at the expense of Sir Stratford Canning, on the spot where the eminent Frenchman, Botta, had begun to work, but were afterwards taken over by the trustees of the British Museum, who indemnified Sir Stratford Canning and paid Mr. Layard's expenses. When Mr. Layard came home, a year or two later, the excavations practically stopped, but were renewed at the expense of the trustees of the British Museum under the direction of a native, Mr. H. Rassam, the plaintiff in the present case. The funds spent by the trustees on these works were provided by the Treasury, and therefore all the results, without exception, belonged to the British Museum by right. In 1873 the late Mr. George Smith made an expedition to Assyria at the expense of the proprietors of the *Daily Telegraph*, with a view of discovering other fragments of the tablet containing the Assyrian account of the Flood. He subsequently made a second and a third expedition to the country (where, in 1876, he unfortunately died) at the expense of the trustees, with funds granted by the Treasury. In 1878 Mr. Rassam again appeared on the scene, and under the authority of a permit from Constantinople renewed diggings in Assyria, and began to open new sites near Babylon, at the expense of the British Museum. It will be seen then that, with very slight exceptions, the money has been found by the British Treasury. We now turn to the results of this expenditure. From the evidence elicited at the trial it appeared that soon after Mr. Rassam began to dig in Babylonia, collections of tablets found their way into the London market, and these were bought by the British Museum for considerable sums of money (*Times*, July 1). If we remember rightly Dr. Budge stated that between the years 1879 and 1882, while Mr. Rassam was excavating, a sum of at least £3000 of public money was spent in this manner. Now as no other excavations were being carried on except by the British Government, and as the internal evidence of the tablets indicated that those which they received from Mr. Rassam as the result of his works and those which they purchased had the same origin, it was natural that the public department should begin to grow uneasy. And this feeling became stronger when it was found that the tablets purchased were of much greater value archæologically and historically than those which arrived at the British Museum from Mr. Rassam. Speaking broadly, it seems from the evidence that Mr. Rassam sent home 134,000 pieces of inscribed clay from Babylonia, and of these more than 125,000 are what Sir Henry Rawlinson, Mr. Maunde Thompson, and Dr. Wallis Budge style "rubbish" (*Standard*, June 30, *Times*, July 3). This represented the direct return for the outlay. What did go wrong we cannot say, but the outsider will certainly think that something did go wrong in this matter. In 1882 Mr. Rassam came home, and in this and the following year collections of tablets and other antiquities of very great value were offered to the Museum for purchase; in fact the supply appears to have been so great that it was some three or four years before the British Museum had funds to buy what it was offered. In 1887 the British Museum despatched Dr. Budge to Mesopotamia with instructions to make investigations into the sources of the supply of tablets which were coming to London, and on many other points, to touch upon which does not concern us (*Times*, July 1; *Standard*, June 29). While in Bagdad Dr. Budge obtained a great deal of information upon the subject of the systematic trade in Babylonian antiquities which was being carried on, and he found that the agent who had been appointed at Mr. Rassam's instigation, and who represented himself as Mr. Rassam's "relation" (*Standard*, June 29), and who was paid by the British Museum to protect the sites, was himself actively engaged in the sale of antiquities. On visiting the sites of the excavations Dr. Budge found that clandestine diggings were going on, and he was also able to purchase many valuable tablets and other antiquities from the peasant diggers (*Times*, July 1). The information which he gathered on all these points he sent home to the British Museum in the form of reports, one of the results of which was the dismissal of the native agent. On two subsequent occasions Dr. Budge visited Assyria and Babylonia, and carried on excavations for the trustees, and he acquired some thousands of tablets.

It will easily be guessed that from first to last a very considerable sum of public money, amounting to tens of thousands of pounds, has thus been spent upon excavations in Assyria and Babylonia, and the question naturally arises, Has this money been spent judiciously, and has the nation obtained what it had a right to expect in return for its money? It seems pretty evident that people other than the trustees of the British Museum have obtained collections of Assyrian antiquities, and it appears to us that this subject should form the matter of a careful and searching investigation. Sales at auctions have revealed the fact that sundry gentlemen had been able to acquire Assyrian slabs from the palaces of Assyrian kings, and as the excavations were carried on by the Government, it is difficult to account for this fact. The public has a right to know how property of this nature came into private hands, and the question must be asked until it is satisfactorily answered. The matter cannot be allowed to rest where it is.

We have seen that it was stated at the trial that in consequence of Dr. Budge's reports the native agent has been dismissed for his pains. Dr. Budge has been mulcted by the verdict of the law-courts in a sum of something over, we hear, £1000. Hence arises another point of wide general interest regarding the treatment which should be accorded to confidential reports from subordinate officers by the higher officials. In the case with which we are at present concerned, Dr. Budge reported such things as he considered to be of importance for the information of his superior officers, and it was, one would think, their duty to sift such reports and to act upon them. For some reason or other, as we gather from the evidence at the trial, the trustees did not act upon them, from which fact Mr. Justice Cave inferred that Dr. Budge in repeating to Sir H. Layard part of the contents of his reports had repeated things which the trustees themselves had considered frivolous and trifling (*Times*, July 4). This, however, is no argument at all, for the reasons of the non-action of the trustees are unknown, and it does not follow that the trustees regarded them as vexatious and trifling. With the terror of the decision in this case before them, all members of the public service will be in duty bound to consider whether they are able to afford the expenses of an action at law, and the enormous costs which follow in its train, before they report unpleasant truths to their superiors. Who can complain if public servants, rather than incur the penalties of the law, hold back information they are in a position to give? Whether this will be good for the public service remains to be seen.

Mr. Justice Cave, referring to the depredations around the excavations, is reported to have said (*Standard*, July 4): "We all know that if you gave £300 for a cylinder like the one produced, it is an incentive for people to steal. It is like the poachers. They will take your own game if you will buy it of them, or they will take it anywhere they can get it." Mr. Justice Cave's facetious remark, however, is scarcely on all fours with the verdict of the jury. He owns that the excavating grounds in question are preserves belonging to the trustees of the British Museum; yet when a keeper reports in general terms that a large amount of poaching has been going on, he is heavily mulcted for his pains, because an individual chooses to assume that he was meant.

Here then are the facts; we believe that so far no action whatever has been taken by the Trustees; still we are glad to learn from the *Daily News* that Dr. Budge's *confrères* at all events have a sense of public duty. That paper states "that the keepers of departments and the assistants in the British Museum have combined to present Dr. Budge with a cheque in settlement of his damages in the recent libel action of 'Rassam *v.* Budge.' It is understood that this is not merely an expression of sympathy with a popular colleague, but that the action of the Museum officers was prompted by a strong feeling that as Dr. Budge has acted throughout in the interests of his department, it would be most unfair to allow him personally to suffer."

BRITISH ASSOCIATION MEETING IN NOTTINGHAM.

A FORTNIGHT ago some account was given of the local arrangements made for the entertainment of members of the British Association during their stay in Nottingham. The accommodation provided for the sections was also indicated. Fuller details on these matters will be found in the local programme now in course of preparation.

With regard to the more serious and useful functions of the Association, something of a preliminary and general character may now be stated.

It is with feelings of great satisfaction that members will welcome Dr. Burdon Sanderson as general president at Nottingham, and it will be unnecessary in a scientific periodical to refer to the eminent service which has been rendered to scientific progress by the president elect.

The acceptance of the following gentlemen of the positions of sectional presidents will also do much to ensure the success of the sections:—Mr. R. T. Glazebrook, Dr. Emerson Reynolds, Mr. J. J. H. Teall, Rev. Dr. H. B. Tristram, Mr. Henry Seebohm, Dr. J. S. Nicholson, Mr. Jeremiah Head, and Dr. H. Robert Munro.

In respect to these appointments universal regret will be felt at the inability of Prof. Clifton to fulfil the duties of the president's chair in Section A, which he had accepted, owing to serious family trouble. But the acceptance of the position by Mr. Glazebrook will beyond doubt cause general satisfaction.

The work of the sections will in part be connected with receiving the reports to be made by the various research committees. Amongst these the following subjects are included:—Electrical standards, meteorological observations on Ben Nevis, the application of photography to meteorology, calculation of tables of certain mathematical functions, recording direct intensity of solar radiation, wave-length tables of the spectra of the elements, an international standard for iron and steel analyses, the direct formation of haloids from pure materials, action of light on dyed colours, isomeric naphthalene derivatives, erratic blocks in England, the fossil phyllopoda of palæozoic rocks, the collection of geological photographs, the circulation of underground waters and their use as water-supplies, the zoology of the Sandwich Islands and of the West India Islands, exploration of the Irish Sea, the inhalation of oxygen in asphyxia, methods of economic training, exploration of ancient remains in Abyssinia, the characteristics of natives of Canada and of India, the recalescent points in metals, volcanic phenomena in Japan, the Pellian equation, the discharge of electricity from points, comparing and reducing magnetic observations, optical constants of lenses, ultra-violet rays of the spectrum, meteoric dust, rate of increase of underground temperature, the bibliography of solution and the properties of solutions, the bibliography of spectroscopy, the silent electrical discharge in gases, the action of light on the hydracids of the halogens in presence of oxygen, the proximate chemical constituents of various kinds of coal, the history of chemistry, the erosion of sea-coasts in England and Wales, the volcanic phenomena of Vesuvius, type-specimens of British fossils, investigation of the remains in Elbolton Cave, structure of a coral reef, the migration of birds, the protection of wild birds' eggs, the teaching of science in elementary schools, graphic methods in mechanical science, prehistoric and ancient British remains, the physical deviations from the normal among children in elementary and other schools.

Amongst the other subjects of general interest, which will probably be introduced and discussed, are the following:—

In Section A the question of the national physical laboratory, of the central publication of physical papers, of magnetic and other units, and of mechanical connection between ether and matter will probably be raised. It is expected that a discussion on the teaching of physics in schools will take place, as well as a joint discussion with Section C on "Earth Tremors."

Section B will receive communications raising discussion on explosions in coal mines, flame, bacteriology, recent progress in inorganic chemistry, and recent research in organic chemistry, especially in connection with colour and colouring matters. The papers on these subjects are to be classified, and each class will be considered on a special day, of which due notice will be given.

In Section C the presidential address will deal with "The Doctrine of Uniformitarianism as illustrated by

recent petrographical research," a subject which Mr. Teall has almost made his own. Papers are expected on East Africa, the new red sandstone of the Midlands, the igneous rocks of Derbyshire, the boulder clays and drifts of the Midlands, the methods and need of teaching geology both as a branch of education and as a valuable training to engineers, miners, and others. Sections C and D will jointly discuss "Fossil and Recent Coral Reefs," both in respect to their origin and in relation to the part which corals have played in the formation of the earth's crust. Sections C and E will also hold a joint meeting for considering the mutual relations of geology and geography.

In Section D Prof. Bohr, of Copenhagen, is expected to communicate the results of researches of great importance on the chemical process of respiration. A discussion will also probably take place on the question how far the fundamental peculiarities of vital processes admit of being explained as merely resulting from the *complication* of the chemical and physical processes of which they consist. It is expected that other moot questions of fundamental importance in biology will also be brought under discussion.

The President of Section E will treat in his address of the Polar Basin, laying stress on some generally forgotten facts and summarising our knowledge of the margin of the Arctic Sea. Mr. W. M. Conway will give an account of his mountaineering experiences in the Karakorum Range. Messrs. Bruce, Burn-Murdoch, and Donald will describe with photographs and paintings the scientific results of a recent sealing expedition to Antarctic waters. Mr. Guy Boothby will describe his journey across Australia from north to south. There will also be papers on the influence of their geographical surroundings upon the people of Northern India, by Mr. E. Henwood, and a similar paper on the Congo Basin by Mr. Herbert Ward. Mr. H. R. Mill will describe the physical geography of the Clyde sea area, and the bathymetrical survey of the English lakes, and Mr. B. V. Darbishire will contribute a paper on some conditions of cartographic representation of distributions.

In Section F the subject of the presidential address will be "The Reaction in favour of the Classical Political Economy." Papers are expected to be read for discussion on the monetary situation by Profs. Foxwell and Cunningham, on agricultural depression by Messrs. H. H. Scott and L. L. Price, on corn averages by Mr. R. Hooker, on Australian banking by Dr. C. Gairdner, on Poor Laws by Dr. F. Wilkinson, on industrial arbitration by Mr. D. Schloss, on the employment of the unemployed, on local industries and the history of Nottingham lace by Mr. Frith and others.

The arrangements for Section G have not been received as yet, but the many promises received from eminent English and foreign engineers to attend the meeting leaves no doubt that the proceedings of this Section will be of unusual interest.

In Section H the subject of the presidential address will be one special phase of man's development. The papers and discussions in this section, always of a diversified and popular character, promise to be of more than usual interest this year. Dr. Hans Hildebrand, Royal Antiquary of Sweden, contributes a paper on "Anglo-Saxon remains, and the coeval ones in Scandinavia," and it is proposed to make his communication the basis of a general discussion, chiefly with the view of defining the special characteristics of Anglo-Saxon remains in this country as distinct from those of Celtic and Scandinavian origin. Another subject, also full of interest and even novelty to English archæologists, is the recently discovered prehistoric lake or marsh village near Glastonbury, which is to be brought before the section by its discoverer, Mr. Arthur Bulleid. As the buried ruins of this village are now being excavated on a larger scale than during the previous summer, it is expected that the amount of industrial remains, already of much archæological value, will be greatly enhanced before the meeting of the Association. It has therefore been suggested that the reading of Mr. Bulleid's report of these researches will be a good opportunity for the eminent archæologists, who have agreed to act as a committee of reference and advice, to discuss the more salient features of this remarkable discovery, and to describe from different standpoints its bearing on the early history of our country. This method of dealing with such a discovery is eminently well adapted both for furthering the objects of the Association and for communicating valuable information to the investigators themselves; and it is earnestly hoped that the committee of experts will find it convenient to be present. Nor do these interesting subjects by any means exhaust the list of the forthcoming materials. Anthropology proper will come largely to the front, and will receive special consideration in the president's opening address to the section, as has been stated above.

Among the more popular scientific communications, the presidential address and the popular evening lectures must take their place. The popular lecturers are Prof. Smithells, who will describe and illustrate his recent researches on "Flame;" Prof. Victor Horsley, who will treat of "The Discovery of the Physiology of the Nervous System;" and Prof. Vivian Lewis, who will lecture to the local working-men on "Spontaneous Ignition." In connection with the last announcement it may be noted that the introduction of the working-men's lecture dates from the last meeting of the Association in Nottingham.

It will probably be possible to make a further communication in our next issue, bringing forward the announcement of the principal arrangements for work and entertainment in a state more nearly approaching completeness and finality. FRANK CLOWES.

MAGNETO-OPTIC ROTATION.

FARADAY'S famous discovery of the rotation of the plane of polarised light by passing the beam through a piece of his heavy glass placed along the lines of force of a magnetic field, was the starting point of the very important department of science now known as electro-optics. From this, as the first observed physical relation between optical and magnetic phenomena, has come the electromagnetic theory of light with all the magnificent researches and discoveries which have marked its experimental verification in recent years. I propose in the present article to give a short account mainly of magneto-optic rotation and the progress which has been made towards its dynamical explanation, followed by a brief discussion of some of the more intimately related phenomena which have been brought to light by recent investigations. It is no part of my plan however to discuss the experimental methods employed in the various researches referred to.

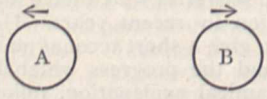
In the first place the magneto-optic relation which Faraday found is to be distinguished from the apparently similar effect which is produced by passing plane polarised light through a plate of quartz cut at right angles to the optic axis, or through a solution of sugar or tartaric acid. In the latter case the turning of the plane of polarisation depends only on the positions of the displaced particles of or in the elastic medium which forms the vehicle of the wave, and not on their motions; in the former the effect is a result of the motions of particles of other matter imbedded in or loading the surrounding ether.

The following illustration is I believe substantially what I have heard given by Lord Kelvin. Imagine two elastic jellies, one bored full of small helical cavities, either all right-handed or all left-handed, and having their axes all in one direction; the other having in it

a number of particles endowed with a spinning motion and reacting in consequence of that spinning motion with centrifugal forces against elastic forces of the surrounding medium, and let the direction of axis and of spin be the same in the different cases. The former jelly will transmit circularly polarised waves travelling parallel to the axis of the helix with different velocities according as the helical arrangement of the displaced particles in the wave does or does not agree with the direction of the helical structure, the latter according as the direction of the motion of the particle caused by the wave is with or against the direction of the spin.

This illustration accounts for the essential difference between the results of observation in the two cases. The turning of the plane of polarisation produced by passing the beam through the quartz, or the solution, in one direction, is undone by sending the beam back again; that produced by passing the beam through a proper transparent medium placed along the lines of force in the magnetic field is doubled by reversing the ray after one passage, and returning the light to the side at which it entered.

To understand what takes place in each case we have to consider the nature of a plane polarised ray. According to the electromagnetic theory of light the disturbance in a plane polarized beam consists of an electric displacement in a direction at right angles to the plane of polarisation as defined in the ordinary way by reflection, and a magnetic displacement at right angles to the electric displacement and to the line of propagation, these two actions in a direct unreflected beam having the same phase. It is as yet impossible to say what it is in the ether that dynamically corresponds to these actions; but there can be no doubt that they are phenomena due to motion of some kind of or in the luminiferous ether. In the elastic solid theory of light, which must whether true or false have a certain correspondence with the facts, each part of the ether in a plane polarised beam was supposed to have a vibratory motion in a straight line at right angles to the direction of propagation, the direction of this line being the same along the whole length of the ray. Such a motion as this, it was first shown by Fresnel, may be regarded as the resultant of two oppositely directed circular motions, simultaneously possessed by each moving part of the ether. For consider a motion which would carry a particle round the circle A in a given time T in the direction of the arrow, and another which

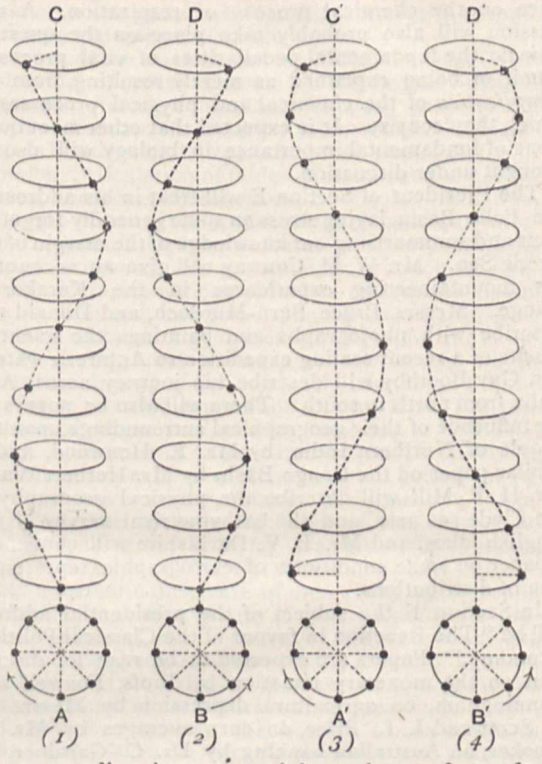


would carry a particle round the equal circle B in the same time in the opposite direction. Imagine two distinct particles to move with equal uniform speeds round the two circles, and suppose that both particles are at the top or at the bottom of their circular orbits at the same time. It is clear that at any given instant both are moving up or both moving down and at the same speed, while when one is moving from right to left the other is moving from left to right with the same speed, and *vice versâ*. Therefore if we conceive these motions united in one particle, the up and down velocities will be simply added together, the right and left motions will cancel one another. Thus the particle will have a simple vibratory motion in a vertical line in the period of the circular motions and with an amplitude of twice the radii of either circle.

Further it is to be noticed that the acceleration of the particle describing this rectilinear motion is the resultant of the accelerations of the particles in the two circular motions and that therefore the force required to maintain the simple harmonic motion is at each instant the resultant of the forces which would have acted on the particles in the circular motions when in the corresponding positions.

Thus the rectilinear vibration of a particle in the luminiferous medium may be regarded as compounded of two circular motions, and the particle as subject to a force compounded of the corresponding forces; and the same may be conceived of each moving particle in the wave.

Now to conceive of the motion in a beam of circularly polarised light and the relative positions of the disturbed particles, let a series of particles initially in a straight line along the direction of propagation be displaced into a helix along that line as represented in the diagram. Let these particles be projected with equal speeds in



the same direction tangential to the surface of the cylinder in which the helix lies, and at right angles to the axis; and further let them be constrained ever after to move with uniform speed in circles round the cylindrical surface. Clearly the helical arrangement will move onward along the cylinder—a circularly polarised wave will be propagated. The helical arrangement, that is the wave, is propagated in one direction or the other, for a given direction of the circular motions according as the helix is right or left-handed, or for the same direction of the helical arrangement according to the direction of the circular motion. Thus the direction of propagation is unchanged if both direction of helix and direction of motion is reversed. All this can be easily made out from diagrams (1), (2) of the figure above. Diagram (1) shows part of a left-handed helical arrangement of particles; (2) part of a right-handed one. Both illustrate the arrangement of particles, originally in a straight line, when disturbed by the passage of a circularly polarised beam. By supposing the particles to have the circular motions indicated below the diagrams, the propagation of the wave can be studied.

It follows therefore that if two such motions co-exist in the same particle both waves will travel in the same direction through the medium. If they travel with the same speed the resulting rectilinear motion of each

particle will be the same all along the wave, but if they travel with unequal speeds the direction of this motion will turn round as the wave advances in the direction of the motion of the particles in the more quickly travelling wave, generating if the speeds are constant, the surface of a screw.

To constrain the particles to maintain the circular motions forces must be applied towards the centre of the orbit in each case. The reactions of the particles against these motions are what are properly called the centrifugal forces of the particles. But the different particles are connected by the elastic medium and the required centreward forces are supplied by its rigidity. Thus for given displacements produced by the beam entering the medium the forces due to the medium will be different if the rigidity is less for, say, a left-handed helical distortion than for a right-handed one, and the latter distortion will be propagated with the greater speed.

Now let the wave be reflected after passage, and let the direction of motion of each vibrating particle be reversed in the act of reflection. The direction of the helical arrangement will remain unchanged in each case. The wave which travelled the faster when direct will again do so, but the direction of motion being reversed the direction of motion in the plane polarised beam will turn round in the opposite direction as the wave moves forward, thus undoing the previous turning.

The same thing it is easy to see will take place if the reflection takes place without reversal of motion as at the surface of a rarer medium. In this case the helical arrangement which was left-handed becomes right-handed, and *vice versâ* after reflection. The arrangement which lagged behind before now that is reversed travels the faster and the line of resultant vibration again turns round, but in the direction of the circular motion in that circularly polarised wave which now moves the faster, that is in the opposite direction to that in which it moved before. Diagrams (3) and (4) of the figure show the configurations of parts of (1) and (2) after having been thus reflected.

Now consider the other case. It is observed, we shall suppose, that the right-handed circular ray travels faster than the other, and that whether direct or reversed. As before, the elastic action of the medium on the moving particles can depend only on the displacements of the particles in the helical displacement, and in the absence of any structural peculiarity to produce a difference must react in the same degree on the particles in both circular waves. Thus the centrifugal force reactions being the same for both waves, and the velocity of transmission being different, the luminiferous motions must be unequal, and such that compounded with a motion existing in the medium two motions are produced which exert equal centrifugal force reactions, balancing the equal elastic forces applied in consequence of the equal helical displacements.

According to this theory, which is due to Lord Kelvin, there exists in the medium a motion capable of being compounded with the luminiferous motion of either circularly polarised beam which is therefore a component only of the whole rotational motion. In the passage in which this dynamical explanation is put forward Lord Kelvin goes on to say,

"I think it is not only impossible to conceive any other than this dynamical explanation of the fact that circularly polarised light transmitted through magnetised glass parallel to the lines of magnetising force, with the same quality, right-handed always, or left-handed always, is propagated at different rates according as its course is in the direction or is contrary to the direction in which a north magnetic pole is drawn; but I believe it can be demonstrated that no other explanation of that fact is possible. Hence it appears that Faraday's optical discovery affords a demonstration of the reality of Ampère's explanation of the ultimate nature of magnetism."

A number of interesting conclusions seem to follow from this theory. In the first place the turning effect is not found to any sensible extent unless there is matter of some kind, magnetic or diamagnetic, present in the field. Hence the theory does not point to rotation of the parts of the ether but only to rotational motion of other matter imbedded in it and reacting on the ether in consequence of that motion.

Further, the explanation seems to decide against that view of diamagnetism which regards it as a differential effect due to the greater magnetisation of the surrounding medium. The rotation of the plane of polarisation is found in both paramagnetic and diamagnetic substances, but for the same direction of magnetic field is opposite in the two cases. This points to opposite rotations of the matter in the field according as it is paramagnetised or diamagnetised.

In all ordinary transparent substances which have been experimented on the effect has been found to be small. This of course was what was to be expected from the small amount of magnetisation (or diamagnetisation) produced in such substances even by very powerful fields. As a rule the substances are diamagnetic and give rotation of the plane of polarisation varying directly as the intensity of the magnetic field in which the substance is placed, and directly as the thickness of the medium through which the light is passed. It has been found however by Kundt that the turning produced by passing the light through a thin film of iron or cobalt is very great, a result which forcibly recalls the idea suggested by Lord Kelvin in the paper quoted above, that the moment of momentum of the matter in unit of volume of the magnetised substance might be the proper dynamical measure of the intensity of magnetisation.

Another result found both for magneto-optic rotation and for the turning produced by substances of helical structure is that the effect is greatest for the more refrangible rays of the spectrum, in fact is nearly inversely proportional to the square of the wave length of the light. This is of great importance in connection with the remarkable theory of the production of magneto-optic rotation in a medium having imbedded a large number of very small gyrostats which has been given by Lord Kelvin. In a continuation of the present article I shall endeavour to give a short account of the behaviour of such a medium when subjected to the disturbance due to the passage through it of a beam of plane polarised light. In connection with this theory the fact observed by H. Becquerel, Kundt and others that magneto-optic rotation is produced also in gases is of great interest.

Absolute measurements made by Lord Rayleigh give for bisulphide of carbon ·042 of a minute of angle for the turning of the plane of polarisation of sodium light in passing through a stratum 1 centimetre thick in a field of 1 C.G.S. unit of intensity the temperature being 18° C. A knowledge of this quantity (which is called Verdet's constant for bisulphide of carbon) enables the turning in other substances produced by a given field to be inferred by experiments of comparison. Further the intensities of magnetic fields can be inferred from observed amounts of turning produced by the passage of light through a column of measured length of any substance for which the constant has been determined.

In a succeeding article an attempt will be made to discuss with as little as possible of the aid of technical mathematics the propagation of plane polarised light in a gyrostatically loaded transparent medium, the "Hall effect" which, existing in a transparent dielectric, would there produce magneto-optic rotation, and to indicate shortly some of the bearings of magneto-optic phenomena generally on the electromagnetic theory of light.

ANDREW GRAY.

THE EARTHQUAKE IN BALÚCHISTÁN.

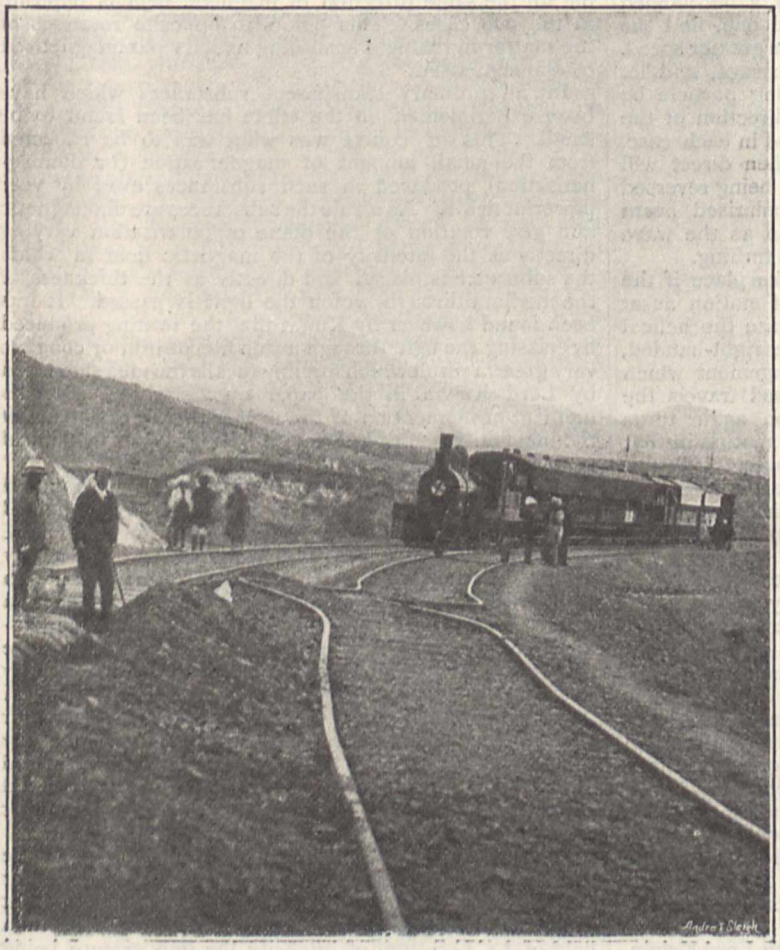
THE *Records of the Geological Survey of India*, May, 1893, contains some notes on the earthquake in Balúchistán on December 20, 1892, by Mr. C. L. Griesbach, one of the Superintendents of the Survey. The paper is illustrated by two photo-etchings, one of which is here reproduced with the description of the occurrence.

The following quotation is from the report of the Executive Engineer of the North-Western Railway at Shalabagh:

"On the 20th December, at 5.40 a.m. (Madras time),[1] this district was visited by a somewhat severe earthquake. It was followed by several lesser shocks, and at Shalabagh[2] they continued at frequent intervals during the day, and have occurred at frequent intervals up to the present date.[3] The exact time of the shock was shown by the stoppage of a pendulum clock in my office.

"*Effects at Sanzal.*[4]—The station building at this place has apparently suffered most, its close proximity to the line of fissure, which runs in a north-east and south-west line about half a mile below the station, being probably the cause. The water tower is standing, but most of the turrets are loose. . . . The oscillation of the ground caused the water to spill out of the iron tanks. . . . The station building, including the station-master's and signaller's quarters and out-houses, are very badly shaken, and will require rebuilding to a considerable extent. The whole of the chimneys have been thrown down.

"Lower down the line the only serious damage to the permanent-way occurred. There is visible at this spot to the eye, for a considerable distance, as far indeed as the eye can reach, a line of division in the soil, and where this intersects the railway at an angle of about 15° or 20°, the metals of the permanent-way were distorted in a most extraordinary way, the pairs of rails in each line immediately above the crack in the ground having suffered most. They were bent into a sinuous curve, which is represented approximately in the accompanying illustration.



View showing distortion of rails caused by earthquake between Sanzal and Old Chaman.

"I have followed the line of fissure in the surface of the ground for a considerable distance on each side of the line, and it extends beyond Old Chaman on the one side for several miles I am told; I myself followed it for one mile beyond Old Chaman, and could then see it extending far into the distance. In the other direction, I am informed by an Achakzai, who had just come from there, it cuts the line of the Khwája Amran range obliquely, and can be traced to the peak of that name, some eighteen miles off.

"There appears to have been a shearing action on the surface of the ground, the line of shear being tangential to the line of cleavage.

"The rails having resisted this motion were crumpled up in consequence. The joints in the rails on each side of the contortion have all been closed up, although of course, originally, clearance for expansion had been left.

"While tracing the crack in the ground through Old Chaman, I found that it crossed all the collecting pipes of the Military Works Department at Old Chaman. Most of these pipes crossed the crack at approximately a right angle and had not suffered, but one 1½ inch pipe which cut it obliquely was pushed up and off the ground and formed a sort of arch over the crack. . . ."

"A week after the earthquake," says Mr. Griesbach, "I visited the Kójak range in company of Mr. Hodson. We first inspected the damage done by the earthquake to the houses and works in the neighbourhood of Shalabagh station at the eastern entrance of the Kójak tunnel. Though there was much mischief done to buildings, &c., not much could be learned from these effects of the earthquake. If the scene of destruction had been in a closely-built town, it might have been possible to detect some method, if I might use the expression, in the damage done, but at Shalabagh the houses are far apart, built on unequal hilly ground, and the workmanship in the buildings, mostly constructed of sun-dried bricks, is also very unequal, so that all one can say is that the shocks of earthquake have affected all the weak points of these buildings, many of which will have to be entirely reconstructed.

[1] At Quetta the shock was felt at 5.46 a.m., the distance from Shalabagh to Quetta being 53 miles in a straight line.

[2] Shalabagh is a station on the Sind-Peshin Railway at the eastern entrance to the Kójak tunnel.

[3] 22nd December.

[4] Sanzal is the first station on the western side of the Kójak tunnel.

"The Kójak tunnel fortunately escaped serious damage, though it is interesting to hear that the water-supply from some springs which issue inside the tunnel and which now escapes in a regular drain from the western (or Chaman side) of the tunnel, was considerably increased after the earthquake shocks.

"The block-house which defends that entrance to the tunnel received some slight damage in the shape of cracks which have appeared in the solid masonry.

"The effects of the earthquake shocks are visible almost all along the made banks on which the permanent-way is laid between the tunnel and Sanzal station. In their case the earthquake acted most beneficially, inasmuch as the artificially built-up material of these banks was well shaken down, and, though the latter had sunk here and there and cracks have appeared in places, their settling down and consolidating was equal to a season's rain, as the engineer of that section reports.

"The real interest of the earthquake, however, centred in the damage done between Sanzal station and Old Chaman.

"The line of railway descends to New Chaman from the Kójak tunnel in several great curves and in zigzag fashion. Sanzal station is situated near the upper margin of a great and rapidly descending glacis, which slopes down from the Kójak range to the great plain in which New Chaman is situated.

"About half a mile west of Sanzal station there is a path which runs from the Khwája Amran peak (8864 feet) in a north-northeast direction along this glacis. It appears that at the immediate foot of the Kójak range a great number of springs rise, close to which of course there is always a certain amount of grazing to be found, and thus this line of springs has been connected by a regular path, made by flocks passing along these patches of pasture-land. The water escaping from these springs has furrowed and denuded the glacis into an infinite number of small channels. Another feature is that the path with its springs and patches of grazing grounds all lie as it were in a natural depression, running parallel with the range of the Kójak itself, whilst immediately to the westward of it the ground of the glacis rises somewhat, before finally descending to the plains. This is well marked near Old Chaman, the foot of which is built on this rising ground.

"About seven to eight miles south of Old Chaman this insignificant rise of ground becomes an auxiliary range of hills, which runs west and parallel with the Kójak range towards the Khwája Amran peak itself.

"I expect to have further opportunities of geologically examining this ground when the weather will permit in the spring; until then I will only state my belief that the present path which connects the springs described indicates, as near as can be, the existence of an old fault-line. At the present time I have no further proof for it than this, that as far as I have been able to ascertain during this hurried visit, the line of path is, roughly speaking, also a geological boundary between the slaty formation of the Kójak and a grey earthy limestone, the latter of which is very probably of upper cretaceous or lower eocene age; this boundary being here suspiciously abnormal in appearance. The springs which rise along it tend further to the opinion that they appear along a line of dislocation, which view is further strengthened by the fact that in the neighbourhood of the springs not only a kind of travertine is visible, but a curious breccia, consisting of debris of both the limestone and the slates of the Kójak and cemented by calcareous rock, is *in situ* and in strong force all along the line of path, but not off it, which breccia I now look upon as a fault-rock. The glacis itself is chiefly made up of recent deposits, fans from the range above, but I hope to discover a more exposed section further south, where the structure of this dislocation, if it is one, will be clearly demonstrated. Finally, but not least, the fault seems to be proved by the earthquake itself, which has originated in a further, though slight, dislocation along a line which exactly and absolutely coincides with the present path connecting the numerous springs.

"In my theory explanatory of this earthquake, I therefore start with the assumption that an old line of fault exists, which runs more or less parallel with the Kójak range itself. In a mountain range entirely formed by flexures, which chiefly correspond to the strike of the range itself, such faults usually exist on a large scale. The lateral pressure which caused the folding of the strata in such cases frequently results in one or several systems of dislocations, as we may observe in numerous instances within folded mountain ranges. . . ."

"From the foregoing it would appear that the process of contracting and folding, with resultant dislocations, of this area in Balúchistán, is still proceeding. At some previous date in the history of the Khwája Amran Mountain range this process of compression, as it must have been, has led to the formation of the line of fault conjectured in these notes; the process, from whatever cause, is still active, and the tension having become too great has further resulted in a slight increase to the amount of dislocation already in existence. The two areas adjoining the fissure have moved about eight inches vertically and a couple or more feet horizontally from each other, which sudden establishment of a temporary equilibrium in this tension is no doubt quite sufficient to account for the vibration of the ground to a considerable distance, which vibration is commonly called an earthquake.

"I need scarcely say that there is no indication of any kind which would point to the existence of volcanic activity at, or anywhere near, the area affected by this earthquake; I mention this only, because it was also in this case, as in other instances elsewhere, the popular theory advanced by many of those who personally experienced the alarming symptoms of this perfectly natural phenomenon."

SCIENCE IN THE MAGAZINES.

OF the August magazines the strongest in articles of scientific interest is the *Fortnightly Review*. Under the somewhat misleading title "The Wanderings of the North Pole" Sir Robert Ball contributes a rather diffuse article descriptive of the variations of latitude; adopting Mr. Chandler's conclusion that the earth's instantaneous axis of rotation revolves about that of maximum moment of inertia, with a radius of thirty feet, measured at the earth's surface, in a period of 427 days. This result is expressed by Sir Robert Ball in the following language:—

In that palæocrystic ocean which Arctic travellers have described, where the masses of ice lie heaped together in the wildest confusion, lies this point which is the object of so much speculation. Let us think of this tract, or a portion of it, to be levelled to a plain, and at a particular centre let a circle be drawn, the radius of which is about thirty feet; it is in the circumference of this circle that the Pole of the earth is constantly to be found. In fact, if at different times, month after month and year after year, the position of the Pole was ascertained as the extremity of that tube from which an eye placed at the centre of the earth would be able to see the Pole of the heavens, and if the successive positions of this Pole were marked by pegs driven into the ground, then the several positions in which the Pole would be found must necessarily trace out the circumference of the circle that has been thus described. The period in which each revolution of the Pole around the circle takes place is about 427 days; the result, therefore, of these investigations shows, when the observations are accurate, that the North Pole of the earth is not, as has been so long supposed, a fixed point,

but that it revolves around in the earth, accomplishing each revolution in about two months more than the period that the earth requires for the performanee of each revolution around the sun.

"What use has a serpent for its tongue?" is a question asked by Ruskin of 'scientific people,' "since it neither works it to talk with nor hiss with, nor, as far as I know, to lick with, and, least of all, to sting with, and yet, to the people who do not know the creatures, this little vibrating forked thread, flicked out of its mouth and back again as quick as lightning, is the most striking part of the beast." Mr. W. H. Hudson furnishes an answer to the question. He remarks: "So far from being silent on the subject, as Ruskin imagined, the 'scientific people' have found out or invented a variety of uses for the serpent's tongue. By turns it has been spoken of as an insect-catching organ, a decoy, a tactile organ, and, in some mysterious way, an organ of intelligence. And, after all, it is none of these things, and the way is still open for fresh speculation." Mr. Hudson puts forward the idea that the snake uses its tongue to concentrate the attention of an intended victim upon its head while its body is being trailed forward to effect the capture. We quote from his article:—

In most cases the movement probably would be detected but for the tongue, which attracts the eye by its eccentric motions, its sudden successive appearances and disappearances; watching the tongue, the long, sinuous body slowly gliding over the intervening space would not be observed; only the statuesque raised head and neck would be visible, and these would appear not to move. The snake's action in such a case would resemble the photographer's trick to make a restive child sit still, while its picture is being taken, by directing its attention to some curious object, or by causing a pocket-handkerchief to flutter above the camera.

Snakes have been observed to steal upon their victims in this quiet, subtle manner; the victim, bird or lizard, has been observed to continue motionless in a watchful attitude, as if ready to dart away, but still attentively regarding the gradually-approaching head and flickering tongue; and, in the end, by a sudden, quick-darting motion on the part of the snake, the capture has been effected. . . .

It is not here maintained that the tongue is everything, nor that it is the principal agent in fascination, but only that it is a necessary part of the creature, and of the creature's strangeness, which is able to produce so great and wonderful an effect. The long, limbless body, lithely and mysteriously gliding on the surface; the glittering scales and curious mottlings, bright or lurid; the statuesque, arrowy head, sharp-cut and immovable; the round lidless eyes, fixed and brilliant; and the long, bifurcated tongue, shining black or crimson, with its fantastic flickering play before the close-shut, lipless mouth—that is the serpent, and probably no single detail in the fateful creature's appearance could be omitted and the effect of its presence on other animals be the same.

In an article on "The Limits of Animal Intelligence," Prof. C. Lloyd Morgan gives an interesting account of some experiments and observations he has recently made on young chicks, with a view of determining the difference between intelligence and instinct. He expresses the distinction between the two as follows:—

Intelligence is the faculty by which, through experience and association, activities are adapted to, or, more strictly, moulded by, new ciccumstances; while reason is the faculty which has its inception in the true grasping of relationships as such. Intelligence is ever on the watch for fortunate variations of activity and happy hits of motor response; it feels that they are suitable, though it knows not how and why, and controls future activities in their direction. It proceeds by trial and error, and selects the successes from among the failures. Reason explains the suitability; it shows wherein lies the success or the error, and adapts conduct through a clear perception of the relationships involved. Individual experience, association, and imitation are the main factors of intelligence; explanation and intentional adaptation are the goal of reason.

Incidentally I have expressed my opinion that, in the activities of the higher animals, marvellously intelligent as they often are, there is no evidence of that true perception of relationships which is essential to reason. But this is merely an opinion, and nos a settled conviction. I shall not be the least ashamed of myself if I change this view before the close of the present year. And the distinction between intelligence and reason will remain precisely the same if animals are proved to be rational beings the day after to-morrow. For the distinction holds good between human intelligence and human reason, just as much as between animal intelligence and the possible reason of animals. It is no line of division which separates animals from men; but a distinction between faculties, one of which, at least (and perhaps both, though this I doubt), is common to animals and men.

The *New Review* contains an article by Prof. Ludwig Büchner on "The Brain of Women." It is well known that the average size of the female brain is considerably less than that of the male. Further, up to the present nothing has been found to justify the assumption that there is anything in the inner formation of the brain to make good its deficiency in size as compared to the male. This Prof. Büchner holds to be due to differences of development.

If we consider that for thousands of years woman, by reason of her subordinate social position, has received a different education from her male partner, and that her training has led her in quite another direction to his; that her horizon has been a more limited one, and moreover that every encouragement has been given to the play of her emotions at the expense of the activity of her intellect; and finally that this state of affairs has lasted from generation to generation, through mother to daughter, then, I say, that from a physiological standpoint there should be no cause for surprise that as a result woman should differ from man, that her brain should be inferior to his, or at any rate should have developed on different lines, or, as we have been saying, that the fore part of her brain should be found to be proportionately less and the hind part proportionately greater than that of man.

Mr. Thomas J. Mays writes in the *Century* on "Breathing Movements as a Cure." The evidence he offers indicates that "proper development and expansion of the lungs by means of well-regulated breathing must be regarded as of the greatest value in the prevention and in the treatment of pulmonary consumption."

"Fin de Siècle Medicine" is the title of an article by Dr. A. Simons Eccles in the *National Review*. After animadverting upon "the deficiency of muscular activity as a fruitful source of maladies resulting from the want of combustion and elimination of material used up or vitiated by the disproportionate action of other organs and tissues," Dr. Eccles describes the investigations that have recently been carried out in France and Russia as to the action of certain organic liquids in curing or modifying disease. Writing on "Electricity and Life" in the *Humanitarian*, Mr. H. Newman Lawrence comes to the following conclusions:—

(1) All the thousand and one changes which take place in the structure of the living body, be they due to the never-ceasing and involuntary process of metabolism, or to the exercise of function, or to the effort of will, partake of the nature of chemical change.

(2) All chemical changes are accompanied by electrical manifestations.

(3) Without chemical change and interchange, life does not appear to exist.

(4) Therefore, life is always accompanied by the generation of electricity.

Electrical energy, however, is not the immediate source of the vitality of the body.

Mr. C. T. Buckland contributes an excellent anecdotal article on "Leopards" to *Longman's Magazine*. Hitherto the beast has occupied only a comparatively small space in the popular literature of natural history, and this fact makes Mr. Buckland's experiences doubly interesting. Under the title "Birds of a Feather," Mr. F. A. Fulcher describes in the *Sunday Magazine* the flocking and

migration of birds. Dr. J. G. McPherson gives a popular description in *Good Words* of Mr. John Aitken's fog-counter and the results that have been obtained with it. Finally, Miss Agnes Giberne expatiates upon celestial photography and spectroscopy in the *Monthly Packet*. The article is in continuation of an easily-worded series she is contributing under the title of "Sun-rays and Star-beams."

MARIÉ-DAVY.

DR. G. H. MARIÉ-DAVY, who died at Clamecy on July 16, distinguished himself in various branches of physical science. Astronomy, electricity, general physics, and meteorology, all occupied his attention from time to time, and to all of these branches of knowledge he made important contributions. Born at Clamecy in 1820, Marié-Davy entered the Higher Grade Normal School in 1840. Five years later he was appointed to the Chair of Physics at the Montpellier Faculty of Sciences, and also to the Professorship of Medicine. In 1862 Marié-Davy began his connection with the Paris Observatory. At first he had charge of the terrestrial magnetism service, but in 1863 he became the head of the international meteorological department that he had organised. While occupying this position he published a large number of meteorological memoirs and initiated the periodic distribution of reports and bulletins. He devoted himself chiefly to the study of the atmosphere and its changes, with special reference to the bearing of such matters upon agriculture and hygiene. In 1857 Marié-Davy invented a mercurous sulphate battery which was adopted by the French telegraph authorities, and also by some of the services in other countries. About this time he contributed numerous papers on statical, dynamical, and physiological electricity to various scientific societies and journals. During the revolution of 1870 he left the Paris Observatory and accepted a Professorship at the Polytechnic School—a post that he retained until the return of the Government to Paris. In 1887 he was nominated honorary director of Montsouris Observatory. Marié-Davy was a doctor of medicine and a doctor of physical and mathematical science. Among other honours he was a corresponding member of the Bureau des Longitudes, and an honorary president of the Société d'Hygiene. He was made a Chevalier of the Legion of Honour in 1877, and possessed the Brazilian Order of the Rose, as well as a number of other orders and dignities. The many and varied researches carried on by him, alone and in collaboration with other workers, testify to his greatness. He had a keen sense of right, and dared to give his opinion even when his material welfare was likely to be injuriously affected by so doing. A life so rich in results and void of dissimulation is one well worthy of being imitated.

NOTES.

M. PASTEUR has been elected an honorary member of the Vienna Academy of Sciences.

ON August 4, at about 6.45 in the evening, a distinct earthquake tremor was felt in Leicester and the neighbourhood. The wave passed from about south-west to north-east, and produced the maximum effect in Charnwood Forest. It is reported that the shaking lasted for about five seconds, during which a loud rumbling noise was heard.

A REUTER'S telegram from Vienna reports that a disastrous cloudburst occurred in Middle Styria on August 5. A number of houses were wrecked and several persons lost their lives. Two railway bridges were thrown down on the Grazkoeflach Railway. At about half-past ten in the morning of August 8 two shocks of earthquake were felt in the Mur Valley. The tremors travelled from north to south.

A SINGULAR occurrence has recently been reported from Gamlingay, Cambridgeshire. What appeared to be a dense cloud was observed, but to the astonishment of the villagers the cloud suddenly broke up and showered myriads of ants and flies upon them. So numerous were the insects that they almost covered the ground like a carpet.

THE southern counties are suffering from a plague of wasps. Judging from the correspondence in the newspapers, the insect has been unusually abundant, and has done a large amount of damage in certain districts. At Heathfield, Sussex, more than a thousand nests have been destroyed this summer, and the work of destruction is still going on.

A GOLD medal of the value of 1000 Italian lire is offered by the Royal Academy of Science of the Institute of Bologna, to the author of the best memoir describing a new and efficacious system, or a new apparatus, for preventing or extinguishing fires. The memoir may be written in Italian, Latin, or French, and must be sent in before May 7, 1894.

THE Report of the Postal and Telegraph Conference held in Brisbane in March last has just reached us. At one of the meetings Sir Charles Todd strongly urged the desirability of adopting a uniform method of reckoning time, and after a short discussion the following resolution was passed:—"That it is desirable in the public interests that the hour zone system should be adopted in a modified form, so that there should be one time throughout Australia, viz. that of the 135th meridian or nine hours east of Greenwich."

MR. EDWIN E. HOWELL describes in *Science* a meteorite observed to fall on May 26, 1893. The meteorite entered the ground to a depth of about three feet at an angle of 58° with the horizon. It is an aërolite of very pronounced chondritic structure, and has the usual black glazed appearance. The weight of the mass is 22½ pounds, and dimensions 6 × 7 × 9½ inches Mr. Howell proposes to give it the name of Beaver Creek, from the stream by the banks of which it fell.

THE *Reale Accademia dei Lincei* has issued a circular in which is given a list of the published papers of the late Prof. E. Betti. In honour of his memory it has been decided to collect and publish the whole of his scientific works, with an account of his life, written by the president of the Academy, Prof. F. Brioschi. In order that the collection may be as complete as possible, the circular asks all who have any unpublished letters of the famous geometrician, or a knowledge of works not included in the list, to communicate with Signore V. Cerruti, R. Accademia dei Lincei, Roma.

THE Society for Promoting Agricultural Science in Vienna will hold an international exhibition between April 20 and June 10, 1894. The exhibition will include specimens of economical food for the people, army supplies, appliances for saving life, means of transport, and sport in all its branches. This exhibition is being promoted by the Archduke Francis Ferdinand. Detailed information on the subject can be obtained from the Consul-General for Austria-Hungary, 11, Queen Victoria Street.

THE Board of Agriculture have been authorised by the Treasury to make arrangements, by way of experiment, for the transmission by telegraph of the weather forecasts, issued each afternoon by the Meteorological Council, to the telegraph offices in the rural districts of two typical counties, for exhibition in the office windows. The experiment will extend over the months of

August and September, should harvest operations continue so long, and Essex and Northumberland are the counties selected for the purpose. The measure of success which the forecasts now obtain is such as to lead the Board to the conclusion that the information thus made available will be of practicable value to agriculturists in making their arrangements for the following day.

SHARP thunderstorms occurred at several places in the south and east of England on Friday and Saturday last, accompanied by heavy rain or hail. In the eastern and northern parts of the kingdom the rainfall has been exceptionally heavy. At York the aggregate amount for the week ended the 5th inst. was 1·6 inch, while at Yarmouth it reached two inches, or nearly the average amount for the month of August.

THE question as to whether the term "perennial spring" is applicable to the climate of Quito, as it is claimed by many explorers of the equatorial city, is discussed by Dr. J. Hann in the *Zeitschrift der Gesellschaft für Erdkunde*. He comes to the conclusion that the term does indeed convey a fair idea of the climatic conditions of the place. Not only does the mean temperature and its range of diurnal variations resemble that of our May, but also the changeable weather, with its afternoon thunderstorms, rains and hailshowers, recalls our spring months. It is possible that the contrast between the cool mornings and evenings may be felt more severely in the capital of Ecuador than with us, on account of the greater power of the vertical rays of the sun, but the variability of the mean temperature is, on the other hand, much smaller than in our latitudes. The influence of the weather upon health is very much the same as that of our springs, attacking, as it does, all the mucous membranes of the unwary traveller. It is a question whether a perennial spring is as much of a blessing as the poets would have us believe. The charm of spring lies in the reawakening of life after the torpor of the winter, and where this contrast is wanting, the greatest part of the charm disappears.

A METEOROLOGICAL Society has recently been established at Zi-ka-Wei, near Shanghai, under the presidency of the Rev. S. Chevalier, S.J., and has issued its first report for the year 1892. A good stock of self-registering barometers has been purchased by the Zi-ka-Wei observatory, and distributed among the members of the Society who were able to make use of them. The report contains a brief account of the principal typhoons of the year 1892, accompanied by a map showing their paths, and also an interesting article upon the fogs along the northern coast of China, based upon the observations made at several stations of the Imperial Maritime Customs during the years 1889-91. The discussion shows that from September to November the coast is remarkably free from fog, but that from March to July fogs are very frequent either at the Shan-tung promontory or near the estuary of the Yang-tse-kiang. They are most frequent in the early morning, by far the greatest number being observed before 9 a.m. The conditions most favourable to their formation occur with a low and still falling barometer.

Science contains an interesting account by Mr. E. H. S. Bailey of the effects of a cyclone that passed near Williamston, Kansas, on June 21. At one point, where the track of the cyclone was about six hundred yards wide, elm and walnut trees two or three feet in diameter were torn up or wrenched off fifteen or twenty feet from the ground. The storm travelled eastward, and the debris was distributed round its centre in the manner that usually characterises cyclonic movements. Barbed wire fencing and telephone wires were lifted into tree-tops about fifty feet north of their original position. Heavy farm wagons were utterly destroyed, and spokes were broken off near the hub and carried to a distance of quite half a mile. But even these are comparatively unimportant items in Mr. Bailey's catalogue of casualties. We learn that gravestones (the size is not stated) were carried three hundred yards, and that chickens were stripped of their feathers and trees of their foliage. The west sides of the trees that stood the storm were much roughened, while the east sides were unchanged, owing doubtless to the fact that clouds of sand and dust accompanied the wind and assisted it in the work of destruction. Just before the storm left the earth's surface its fury was at the highest pitch and the width of its track was least. The length of the track, as shown by the devastation, was about five miles.

WE learn from the Kew *Bulletin* that the fine collection of *Stapelias* made by the late Mr. Thomas Westcombe, of Worcester, has been presented to the Royal Gardens, together with a number of notes, descriptions, and beautifully executed coloured drawings.

THE *Bulletin* of the Royal Gardens, Kew, Nos. 76, 77, contains an elaborate report on the preparation and export of Chinese white wax. The eggs of the *Coccus* which produces the excretions are invariably transported from the district where they are produced to that in which the wax is obtained. The industry appears to be a decaying one.

THE first three parts of vol. iii. of "Indian Museum Notes," published under the authority of the Agricultural department of the Government of India, contains a great mass of information on the causes of the various diseases which affect crops in India, descriptions of noxious insects, &c. It is edited by Mr. E. C. Cotes, Deputy Superintendent of the Indian Museum, who himself contributes a large number of notes. The third part is entirely occupied by a conspectus of the insects which affect crops in India, 240 in number.

IT would appear from researches made by Fromme and Stagnitta-Balistreri that no inconsiderable number of micro-organisms are capable of producing sulphuretted hydrogen. Fromme employed as culture media ordinary nutritive gelatine to which tartrate, acetate, or saccharate of iron had been added, the reaction being exhibited by the varying shades of brown to black produced by the organism's growth. Balistreri (*Archiv f. Hygiene*, vol. xvi.) used broth with and without peptone, and tested for the presence of this gas by the insertion of strips of lead paper. Amongst those organisms which produce sulphuretted hydrogen are the *B. proteus vulgaris*, the typhoid bacillus, *B. coli communis*, bacillus of rabbit septicæmia, the comma bacillus, whilst *B. subtilis*, the anthrax bacillus, *Micrococcus tetragenus*, the diphtheria bacillus yield a negative result. On substituting for beef broth that prepared from veal, horse-flesh, or haddocks, no difference in the behaviour of the organisms investigated was observed. When inoculated into raw eggs, which contain such a large proportion of loosely combined sulphur, the *Proteus vulgaris*, associated with so many processes of decomposition, failed, in spite of abundant growth, to produce any sulphuretted hydrogen. On boiled eggs, however, this microbe produces this gas. These interesting results suggest that the power of evolving sulphuretted hydrogen may be possessed in a latent state by certain bacteria, and that just as particular conditions may stimulate their activity in this direction, other circumstances may act as a deterrent.

THE power of gradually adapting themselves to their surroundings possessed in such a remarkable degree by many micro-organisms, has been studied as regards their susceptibility to various strengths of disinfectants by Kossiakoff, and still more recently by Trambusti (*Lo Sperimentale*, 1892, fasc. i.). Kossiakoff showed that a larger dose of a particular disinfectant was necessary to destroy an organism which had been trained by being subjected to gradually increasing doses of the disin-

fectant than was required when the organism was submitted to it without any such preparation. Trambusti examined the behaviour of various bacteria in the presence of corrosive sublimate, and found that they exhibited striking differences in their ability to withstand this material. Thus whereas the pneumococcus of Friedländer was trained to survive an addition of 1 : 2000 parts of the sublimate to the culture media, the bacillus of fowl cholera was not able to withstand more than 1 : 30,000. If, however, the pneumococcus were taken straight from a fresh culture without any previous experience of the disinfectant, it succumbed in a solution containing 1 : 15,000 parts. The bacillus of swine plague (Rouget des Porcs) was induced to resist an addition of 1 : 8000 parts, whereas without training 1 : 15,000 parts infallibly destroyed it. As regards the retention of their pathogenic properties amongst those organisms investigated, the bacillus of swine plague was the only instance in which the virulence was diminished during its treatment, an addition of 1 : 20,000 parts of corrosive sublimate rendering it innocuous, although its vitality was not destroyed in the presence of 1 : 8000 parts.

MESSRS. E. AND L. MACH have done a considerable amount of work in connection with the photography of flying bullets, air jets, and sound waves since their last publication on this subject. Some results gleaned from a series of about 1500 negatives have been recently communicated to the Vienna Academy. Sharp images of Mannlicher rifle bullets were obtained of 3·5 cm. diameter. The disturbing electric contacts in the field were dispensed with, as it was found possible to close the spark circuit mechanically by means of the sound wave produced by the bullet itself. A large number of experiments were conducted with the interference refractometer invented by Ludwig Mach, and constructed in a complete form with the aid of the Academy. After some trials they succeeded in producing homogeneous plane-parallel glass plates large enough to obtain an interference field 8 cm. in diameter. If one part of this field is occupied by a projectile, an air jet, or a sound wave passing one of the interfering pencils, the interference bands, usually rectilinear, appear bent in such a manner as to indicate the change of density of air at any point. For the purpose of instantaneous illumination the electric spark was usually employed, but sometimes, especially in cases where a longer illumination was admissible, as in the photography of air jets, blue monochromatic sunlight was substituted.

A SIMPLE instrument for trisecting any given angle, invented by Dr. E. Eckhardt, is described in the *Naturwissenschaftliche Wochenschrift*. A straight rule has a slot running along two-thirds of its length, with a pin capable of moving along it. A bar is attached to this pin, and another bar to a rivet at the inner end of the slot. Both these bars are equal in length to the remaining third of the rule, and their free ends are joined by means of another pin. When it is desired to trisect an angle, the pin moving in the slot is placed at the vertex, and the other pin in one of the sides, a parallel to the other side, being drawn through the point occupied by the pin. A curve is now drawn by means of a pencil attached to the unslotted end of the bar, and the intersection of this curve and the parallel referred to is the point of trisection required. The instrument also gives an easy construction for an angle of 36° and for the performance of the "golden section." It is exhibited at Chicago by "The Prussian Universities."

AT a recent meeting of the Société Française de Physique, M. E. Ducretet described a method he had employed for making high resistances without self-induction, and hence suitable for use with a telephone in Kohlrausch's method of measuring resistances. He uses a zigzag formed on platinised glass very like that, composed of fine platinum wire, used by M. Mergier, and finds that a piece of platinised glass 75 mm. by 110 mm., allows of the construction of resistances varying from 25 to 100,000 ohms. The glass plates are fixed in a glass vessel by means of an insulating cover, and this vessel is filled with purified petroleum, which M. Pellat has shown to be a very good insulator. In this manner all effects due to moisture in the air are removed, while it is easy to measure the temperature. A layer of mercury, of variable thickness, at the bottom of the vessel allows of the resistance being adjusted to any desired value.

WHILE engaged on some measurements on the electrical resistance of the human body M. Mergier was led to the construction of a simple instrument which, while being easily manipulated, should be capable of making such a measurement with accuracy. The instrument consists of two coils of insulated wire, fixed with their planes at right angles to each other, and placed within the field of a strong horse-shoe magnet. These two coils are connected in series with the resistances to be compared, and to the terminals of a battery. Under these circumstances, the position of equilibrium of the coils depends only on the ratio of the resistances of the two branches (coil and added resistance), and is independent of the value of the electromotive force of the battery. The current is led into the coils by three metallic points, placed one vertically above the other, and dipping into mercury cups. The coils are suspended by a silk fibre or from a steel point working in an agate cup. For use with alternating currents the magnet is replaced by two fixed coils, which are also connected to the circuits containing the resistances to be compared.

MESSRS. DEIGHTON, BELL AND CO. have published a second edition of Dr. W. H. Besant's excellent "Treatise on Dynamics."

MESSRS. J AND A. CHURCHILL have issued a little volume entitled "Homburg-Spa: an Introduction to its Waters and their Use," by Dr. Arnold Schetelig.

WE have received a report containing the results of observations made at Magdeburg meteorological observatory during 1891, under the direction of Herr A. W. Grützmacher.

DR. R. W. SHUFELDT, in *The Auk* of July, gives an account of an examination of the trunk skeleton of a hybrid grouse. His observations confirm an opinion expressed some years ago, that of all the North American grouse, the genera *Pediocaetes* and *Tympanuchus* are most nearly related to each other; in fact, so close is the relation, that the species are fertile *inter se*.

BULLETIN 42 of the Purdue University Agricultural Experiment Station contains a paper by Mr. J. C. Arthur on the relation of the number of eyes on the seed tuber of the potato to the crop obtained. The experimental data brought forward indicate that the proper way to cut potatoes for planting is to divide them into pieces of suitable size, without regard to the distribution of the eyes. In other words, the number of eyes per piece is immaterial, so that the weight or size of the piece should be the all-important factor in preparing seed material.

THE annual report of the Royal Botanic Garden, Calcutta, of which Lieut.-Col. G. King, F.R.S., is superintendent, has been issued. From it we learn that all the efforts to introduce the cultivation of the Japanese paper mulberry have failed. As the superintendent points out, this mulberry yields a beautiful fibre, which is naturally so white that it requires very little bleaching, hence it seems a pity that no wealthy landowner has taken up its cultivation on a large scale.

THE administration report of the Central Museum for 1892–93 has been prepared by Dr. H. Warth, officiating superintendent,

and recently issued by the Government of Madras. It includes an account of corundum deposits in the Madras Presidency, and one on the phosphatic nodules of the Trichinopoly district. Dr. Warth says that the entire area covered by these nodules is about ten square miles, and that about four thousand tons of nodules are lying more or less loosely on the surface.

THE fourth volume of the Bulletin of the American Museum of Natural History contains a large number of important papers, among which we note one by Prof. H. F. Osborn and Mr. J. L. Wortman on "Fossil Mammals of the Wahsatch and Wind River Beds," and another by Mr. J. A. Allen on "The Geographical Distribution of North American Mammals." Mr. F. M. Chapman contributes an article on birds and mammals observed near Trinidad, Cuba, with some remarks upon the origin of West Indian bird life, and Mr. W. Beutenmüller gives several papers on Lepidoptera.

THE proceedings of the Bristol Naturalists Society for 1892 contains several interesting papers. Among others of general scientific interest we note a paper describing the fish-remains of the lower carboniferous rocks of the Bristol district, by Mr. A. J. Heath and Prof. C. Lloyd Morgan. Mr. Claud Druit gives an account of the Green Woodpecker, and Mr. H. J. Charbonnier contributes some notes on the habits of the larvæ of Gracillaria Syringella. Dr. J. A. Norton writes on the coloration of cuckoo's eggs. We regret to learn from the report that this once flourishing society is declining in numbers.

MESSRS. NEWTON AND CO., Fleet Street, have brought out a new kind of gyroscope top, which should be of interest to students of the dynamics of rotation. In it a shallow bell with heavy rim takes the place of the usual disc. At the inner apex is a point which rests on a steel cup in the top of a firm upright. By means of this support, freedom of motion in different planes is obtained without the use of gimbals. The top can be set spinning by twirling it between the fingers, and, owing to the fine workmanship, it will keep in motion for a considerable time. If any geometrical figure made by bending a piece of stout wire is fixed above the point of support, the upper end of the axis of the top follows the form so long as rotation is obtained, running continuously round it in a very remarkable manner. If the top were intended for a gyroscope, its axis should always remain parallel to itself unless guided in the way described. But this is not the case. The axis slowly gyrates and wobbles as it does so. These motions certainly imitate precession and nutation, but the mode of exemplification may lead beginners to a misconception. There is a possibility of being led away with the idea that the earth's axis changes its direction by itself, whereas it cannot be too strongly insisted upon that the effect is produced by external attraction.

AN important communication upon the production of ozone at high temperatures is contributed by Dr. Brunck, of Freiberg to the current number of the *Berichte*. The very title of the memoir is contrary to all our usually accepted ideas concerning the stability of ozone, but Dr. Brunck advances experimental evidence to show that polymeric oxygen is capable of formation and of subsequent existence for a short time even at temperatures of considerable elevation. It is quite true, as Andrews and Tait long ago pointed out, that at 300° ozone is converted into ordinary oxygen, indeed, Prof. Andrews gave 237° as the temperature of dissociation; but Dr. Brunck shows that the change is by no means instantaneous, and that if the gas is only allowed to remain for a short period of time in the heated vessel, a considerable proportion escapes decomposition. A quantity of oxygen was partially ozonised in the ordinary manner by means of a Siemens tube, and the gases, which contained about five per cent. of ozone, were led very slowly through a combustion tube heated to 350° in an air bath; the issuing gas was found to still contain twenty per cent. of the original quantity of ozone present. Filling the combustion tube with fragments of porcelain did not appear to materially diminish the quantity of ozone escaping dissociation. Dr. Brunck then proceeds to describe several high temperature reactions in which oxygen is liberated to a not inconsiderable extent in the condensed form of ozone. Schönbein some years ago made the remark that the oxygen evolved upon heating certain metallic oxides and peroxides appeared to contain ozone, inasmuch as it rapidly liberated iodine from potassium iodide. This statement, which appears to have been overlooked or mistrusted, is completely confirmed by Dr. Brunck, who shows that oxide of silver evolves as much as five per cent. of its oxygen in the form of ozone.

THE most interesting portion of Dr. Brunck's paper, however, is that in which he adduces experimental evidence that the strongly odourous gas hitherto considered to be chlorine, which is usually admixed to a slight extent with the oxygen prepared by heating a mixture of potassium chlorate and manganese dioxide, is in reality ozone. It is certainly singular that Marignac, on attempting to determine the amount of such admixed so-called chlorine in a strongly odourous specimen of the gas, only obtained three milligrams of silver chloride from fifty grams of potassium chlorate. Dr. Brunck now shows that an aqueous extract of the residue in the flask, after heating the mixture of potassium chlorate and manganese dioxide, always reacts neutral to litmus; whereas if free chlorine were evolved the residue must of necessity be alkaline. Moreover, even after repeated washing of the gas with concentrated solutions of caustic potash, sufficient to remove any free chlorine, the gas still maintains its strong odour, at once forms blue iodide of starch with a starch and potassium iodide paper, and bleaches a moistened litmus paper. Further, upon leading the gas through alcohol, aldehyde is produced, an oxidation which free oxygen alone is incapable of bringing about. The active properties and the odour are, however, completely lost after passage of the gas over a layer of manganese dioxide at the ordinary temperature, as would be the case if ozone were the energetic gas present in the oxygen. The above experiments concerning the comparative stability of ozone for a short time at high temperatures quite account for the formation of ozone when a mixture of potassium chlorate and manganese dioxide is heated. Dr. Brunck finally shows that the amount of ozone produced is considerably augmented by removing the escaping gases more rapidly from the heated mixture by means of a current of air or other inert gas. Pure potassium chlorate appears to yield no ozone upon heating, but a mere trace of impurity, such as potassium chloride or silica, causes more or less of the oxygen to be evolved in the form of ozone. Hence commercial chlorate always yields a small proportion of ozone.

NOTES from the Marine Biological Station, Plymouth.—The floating fauna has now begun to assume its distinctive autumn characters. During the past week there were taken, in addition to the larvæ of *Chætopterus*, *Amphioxus* larvæ, the *Tornaria* larva of *Balanoglossus*, numbers of *Plutei* and some *Bipinnariæ*, larvæ of the Polychæta *Magelona* (very young), *Pectinaria*, and *Polydora*, together with scores of *Pilidium*. Medusæ were very plentiful, especially the Leptomedusæ *Laodice cruciata*, *Obeliæ*, and an unidentified *Irene*-like Phialia, and, among Anthomedusæ, a small Margelid. There were also taken two specimens of a species of *Geryonia*, and several of the amethyst tentacled *Amphinenia Titania* (= *Saphenia dinema* of Forbes). *Noctiluca* has reappeared in small numbers. *Evadne Nordmanni* is extremely plentiful; *Podon* on the other hand is relatively scarce. The following animals are now breeding:—The Cladoceran *Evadne Nordmanni* (most carrying embryoes, some provided with the "winter egg"), and a few Lobsters (*Homarus vulgaris*).

THE additions to the Zoological Society's Gardens during the past week include a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, presented by the Rev. W. Meikleham; a Brown Capuchin (*Cebus fatuellus*) from Guiana, presented by Mr. T. Birks; a Rhesus Monkey (*Macacus rhesus*) from India, presented by Dr. G. Lindsay Johnson, F.Z.S.; a Leadbeater's Cockatoo (*Cacatua leadbeateri*) from Australia, presented by Capt. St. G. Ord; an Imperial Eagle (*Aquila imperialis*), two Great Eagle Owls (*Bubo maximus*) European, presented by Mr. Charles Clifton Dicconson, F.Z.S.; a Common Jay (*Garrulus glandarius*) British, two Alligators (*Alligator mississippiensis*) from the Mississippi, presented by Mr. Walter D. Marks; a Yellow-billed Sheathbill (*Chionis alba*) cap. at sea off Staten Island, presented by Capt. E. England; seventeen Guillemots (*Lomvia troile*), two Puffins (*Fratercula arctica*), twelve Kittawakes (*Rissa tridactyla*) British, presented by Mr. Thomas A. Cotton, F.Z.S.; a Cape Crowned Crane (*Balearica chrysopelargus*) from South Africa, presented by Mr. E. S. Spooner; two Peregrine Falcons (*Falco peregrinus*) from Ireland, presented by Capt. R. A. Ogilby, F.Z.S.; a Larger Hill Mynah *Gracula intermedia*) from Northern India, presented by Dr. Best; two Montagu's Harriers (*Circus cineraceus*) European, presented by Lord Lilford, F.Z.S.; ten Slowworms (*Anguis fragilis*) British, presented by Mr. F. A. Leach; a Black Rat (*Mus rattus*) British, presented by Mr. Arch. E. Scott, F.Z.S.; a Brown Capuchin (*Cebus fatuellus*) from Guiana, a Ring-tailed Lemur (*Lemur catta*) from Madagascar, a Ring-tailed Coati (*Nasua rufa*) from South America, deposited; a Yak (*Poephagus grunniens*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET 1893 (RORDAME-QUÉNISSET).—Herr E. Lamp gives a four-day ephemeris for this comet in *Astronomischen Nachrichten*, No. 3175, as obtained by using the elements he published in a previous number of the same journal :—

12*h*. *Berlin M.T.*

1893.	R.A. (app.) h. m. s.	Decl. (app.) ° ′
August 8 ...	12 9 29 ...	+12 28·8
12 ...	12 12 51 ...	11 7·2
16 ...	12 15 38 ...	9 58·7
20 ...	12 18 2 ...	8 59·8

This comet is now rapidly fading, and at the same time becoming very unfavourably situated on account of its rapid southerly motion.

COMET FINLAY 1893.—The following is the current ephemeris for Finlay's comet :—

12*h*. *Paris M.T.*

1893	R.A. (app.) h. m. s.	Decl. (app.) ° ′ ″
August 10 ...	5 57 30·2 ...	+23 7 14·3
11 ...	6 1 16·4 ...	9 53·9
12 ...	5 0·6 ...	12 12·3
13 ...	8 42·6 ...	14 10·0
14 ...	12 22·5 ...	15 47·6
15 ...	16 0·3 ...	17 5·8
16 ...	19 35·9 ...	18 5·1
17 ...	6 23 9·3 ...	23 18 46·0

TOTAL SOLAR ECLIPSES.—Under this heading Mr. Turner (*Observatory*, No. 204) says a few words about the results of the late eclipse and also the total eclipse that will occur on August 8, 1896. With regard to the former the observers who went out may be thoroughly congratulated on their performance. The photographs that were taken of the corona are, as Mr. Turner informs us, now in the hands of Mr. Wesley, who will make drawings of them, as he has done in the case of previous eclipses. During his recent visit to England Prof. W. H. Pickering compared the photographs he took with those already mentioned, with the result that many most interesting points have been revealed. Prof. Pickering, it may be remembered, employed one of Dr. Common's 20-inch reflectors of 45-inch focus, and, used slow plates, with the result that he "has got more detail in the inner corona than is shown on the English photographs." Referring to the eclipse of 1896 Mr. Turner points out the importance of making preparations a long time beforehand, in order to eliminate the possibility of hasty arrangements at the last moment. In the case of this eclipse it seems not a bit too early to commence, for, owing to the most favourable position of the central line of totality, it is probable that a host of observers, both professional and amateur, will be able to co-operate in the observations.

The central line cuts through Norway in the north, the east coast being the more favourable both for observation and comfort in travelling. Passing across Nova Zembla the line reaches Japan, and thus, as Mr. Turner says, "another delightful trip is open to any one with plenty of leisure."

The details of the eclipse are as follows :—

	At Varanger Fjord. d. h. m. s.	Nova Zembla. d. h. m. s.	Siberia. River Amur. d. h. m. s.	Japan. I. of Yezo. d. h. m. s.
Eclipse begins Aug.	8 16 59 43 ...	8 18 30 1 ...	9 1 16 13 ...	9 1 55 8
Totality „ „	8 17 55 37 ...	8 19 28 59 ...	9 2 27 31 ...	9 3 5 26
Eclipse ends	8 18 55 31 ...	8 20 31 54 ...	9 3 36 54 ...	9 4 13 10
Duration of totality	0 0 1 46 ...	0 0 2 0 ...	0 0 2 46 ...	0 0 2 40
Sun's alt. at totality	15° ...	22° ...	46° ...	43°

THE OBSERVATION OF AURORÆ.—We have previously had occasion to refer to the movement for systematically recording the occurrence of auroræ which has been set on foot by Dr. M. A. Veeder. Public attention has lately been called to the matter by a long article in the *New York Sun* describing the plan of observation and the important results that must follow from its extended adoption. The method of observation is very simple, and requires but little time. Each observer indicates on the blanks supplied for the purpose the presence or absence of the aurora. Whenever the fact has been verified by observation the figures denoting the exact time at which the observation was made are entered in the proper space in the blank. The facts which it is especially desired to learn are the exact times of sudden changes in the brightness of the aurora, the extent of sky which it covers, and its position relative to the true north. In case observations are not made the spaces are simply to be left blank. Each blank sheet prepared in this way covers an entire month, and is arranged so as to enable comparisons to be made at a glance between the records from different stations. Only by the coordination of results uniformly recorded can any definite information be obtained as to the distribution, periodicity, and source of luminosity of auroræ. Dr. Veeder has employed his scheme of observation for some years, and finds that it works satisfactorily. Arrangements have been made for its introduction into the observatories of Archangel, Pawlosk, Ekatrainbourg on the Ural mountains, Irkutsk in Siberia, and at other points. The Director-General of the Italian Meteorological Service has also written expressing approval of the purposes of the research, and promising to aid it in every way possible. American observatories have also taken up the system, and other observations have been provided for on an extensive scale, so interesting and important results may be expected. Those who desire to take part in the work can obtain all information relating to it by application to Dr. Veeder, Lyons, New York.

NEW DETERMINATION OF THE CONSTANT OF UNIVERSAL ATTRACTION.—In a note under this heading on July 27 we gave a list of some of the different values obtained for the density of the earth. The following should be added to make it more complete :—

Jolly and Poynting, by the method of weighing, obtained 5·58 as the value for the mean density.

Wilsing's determinations in 1887 and 1888 gave 5·58 with a very small probable error.

"HIMMEL UND ERDE" FOR AUGUST.—In the current number of this periodical Prof. von Braunmühl contributes the discourse which he delivered before the Mathematical Society at München on "Galileo Galilei." Dr. Wilhelm Meyer continues his series of chapters on the planet Mars, and in this one he is able to reproduce some of the most interesting drawings of Prof. J. M. Schaeberle, made at the Lick Observatory. The discussion deals chiefly with the observations made and the suggestions put forward by such observers as Holden, Schaeberle, Barnard, Pickering, &c. Chapter v., on "The origin of the world

according to opinions from the time of Kant up to the present," by Herr Guizel, deals with the process of development of the heavenly bodies, the case of comets receiving the writer's special attention.

Among the notes are found a few words about the sun and magnetic storms, with reference to Lord Kelvin's recent views, types of weather in Australia, driving ice in southern latitudes, and several others.

GEOGRAPHICAL NOTES.

THE question of the death of Emin Pasha is again under discussion. It is one of the most difficult problems associated with Africa to estimate the amount of credence due to native or Arab reports. The dictum that bad news travels fast in Africa has been repeatedly proved, but rumours of the death of every explorer of note who has buried himself for a time in the interior have been so persistent and so often falsified, that hesitation is justified in believing Emin dead. It may very well be that he was killed, as Arab report affirms, in October last, while on his great journey across Africa, by the very route which brought Stanley to his rescue five years ago. But on the other hand, it may very well be that he is pushing on leisurely towards Lake Chad and keeping his movements secret for political purposes.

A NEW field of discussion in geography appears to be about to open if we read literally the title "An Undiscovered Island off the northern coast of Alaska," in the last part of the *National Géographic Magazine*. The existence of an island in 73½° N. and 153½° W., north of Point Barrow, is inferred from some rather vague reports of whalers, and some still vaguer stories of the Alaskan Eskimo. Mr. Marcus Baker, who introduces the new land, believes in it sufficiently to propose the name Keenan Island for it; but General Greely contributes a note to the paper in which he shows good reason for believing that the whalers were mistaken, the Eskimo misunderstood, and the new land non-existent.

THE *Revue de Geographie* commences a series of articles on "Questions Géographiques," with a paper on the gaps in our knowledge regarding the vertical relief of France, by M. A. Thalamas. To fill these he urges the importance of supplementing the ordinary hypsometrical maps by sections, and by a complete series of perspective photographic views taken from characteristic points.

THE Rev. R. P. Ashe, author of the standard work on Uganda, and for many years resident there as a missionary, has returned to this country, bringing much valuable information regarding the geography of Eastern Equatorial Africa, which will doubtless soon be made public.

A NEW Geographical Society has been established at Tunis, having for its special aim the study of that protectorate. Not only geography but history, archæology, anthropology, colonisation, commerce, and "natural science" have places on its programme.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE Institution of Mechanical Engineers held their annual summer meeting at Middlesborough, under the presidency of Dr. William Anderson, F.R.S., during last week. The meeting commenced on Tuesday, August 1, and lasted until the following Friday. Two sittings were held for the reading of papers, four of which were read and discussed, as follows:—On recent developments in the Cleveland iron and steel industries, by Mr. Jeremiah Head, past president, chairman of the reception committee.—On the Middlesborough salt industry, by Mr. Richard Grigg, of Middlesborough. Communicated through Mr. E. Windsor Richards, vice-president.—On some engineering improvements in the River Tees, by Mr. George Clarke, of Stockton, engineer to the Tees Conservancy Commission. Communicated through Mr. Thomas Wrightson, M.P., chairman of the works committee of the Tees Conservancy Commission.—Description of the electric rock-drilling machinery at the Carlin How Mines in Cleveland, by Mr. A. L. Steavenson, of Durham. Communicated through Sir Lowthian Bell, Bart., F.R.S., past president.

Mr. Head's paper, as its title denotes, was of a very complex nature. The author traces the rise and progress of the iron industry in the Cleveland district, which, before the development of the ironstone in the Cleveland hills, was practically a purely agricultural country. The opening of the Stockton and Darlington Railway inaugurated a new era, which was to dawn over this part of the kingdom, and substituted for the calm frugality of a pastoral calling the grime, smoke, wealth and squalor of a manufacturing industry. John Vaughan was the man who made Middlesborough, and rightly his statue stands in the middle of that unlovely town. He was a typical pioneer, dogged of purpose, shrewd yet kindly. He probably did more towards advancing the commercial supremacy of this country than any six statesmen the century has produced. The first blast furnaces were erected in the Cleveland district by his firm, Bolckow, Vaughan and Co., at Middlesborough, in 1852. These were quickly followed by others at Port Clarence near by. They were erected by Bell Brothers, and Sir Isaac Lowthian Bell, the head of the firm, attended at the meeting and spoke in the discussions on the papers. Although advanced in years he is still a keen man of business and of vigorous intellect; the present Mayor of Middlesborough is his son. After the date we have mentioned Middlesborough grew like a gourd and flourished like a bay-tree. Her prosperity seemed as firmly founded as her gigantic blast furnaces, which were then the wonder of the whole iron-making world; but a greater man than either Vaughan or Bell arose, and with the invention of Henry Bessemer, the iron age gave place to the age of steel. Happily for Middlesborough it is difficult, to divert the course of trade although the Cleveland ore is not suitable for steel making; or at any rate, was not until the basic process was introduced years afterwards. Middlesborough is well situated for communication by sea with the continent. The great deposits of hæmatite ore, from which by far the greater part of British steel is made, were discovered at Bilbao, in Spain, and Cleveland set vigorously to work to improve the naturally insignificant stream upon which she is situated. With characteristic northern energy the Tees was transformed from a creek with three and a half feet at low water, spring tides, to an estuary with twenty feet as a minimum depth and thirty-seven feet at high water. The ironmasters of the district, who had become numerous and influential, quickly laid down the necessary plant and machinery for making steel. Unfortunately, in a few instances, but those important ones, the vigorous parent stock was succeeded by a more debased growth and that for a time checked to some extent advance, or at any rate gave other districts an advantage; still the iron industry of Cleveland was so firmly established that it still remains the leading iron-producing district of England. At the present time Middlesborough is suffering, like all other parts of the kingdom, from the dulness of trade. There are more blast furnaces, more converters, more open hearth furnaces, and more steel and iron-producing machinery in the world than the world has call for. The engineer has so multiplied manufacturing facilities that we make more than we want, great as is the demand for iron and steel in modern economy. When process was cheapened by the ingenuity of inventors, those who first took advantage of the new means at their disposal became quickly rich. Investors and speculators crowded on to the field, and before the fact was known the producing power of man in the iron industry had been overdone. Sometimes in those strange fluctuations of trade which are the baneful characteristic of the present day, the demand more nearly reaches the power of supply; then for a few months, on the crest of this wave of inflated prosperity, works are busy and prices high. That lasts but a short time, and during the recent meeting the members of the Institution of Mechanical Engineers had the mournful spectacle presented to them of idle plant and unemployed workpeople, although each works manager put as bold a face as possible on his adversities, and strove to crowd as much work as his order book contained into the one day's visit of the institution.

To return, however, to Mr. Head's paper. We find that in 1872 there were thirty-seven iron works in the north-east district. Twenty-one have since disappeared or are now inoperative; whilst nineteen remain. The figures are delusive, for the size and power of production per works are now far beyond what they were at the earlier date. To show how steel has superseded iron, we find by the paper before us that the trade in iron rails has declined nearly 99% since 1872; whilst other kinds of

finished iron have declined to the extent of 36% since the same date. Instead of finished iron absorbing 40% of the Cleveland pig-iron made as in 1872, in 1891 it absorbed only about 23%. The quantity of ore raised in Cleveland in 1872 was about 6,300,000 tons, and the quantity of pig-iron made in the north-east district about 1,920,000 tons. During the year 1891 there were produced in the north-east district 795,487 tons of steel ingots. In the latter year 2,260,000 tons of ores other than Cleveland were smelted and of these about 2,100,000 tons were imported chiefly from Spain. On the whole, there has been produced in this district about 36% more pig-iron than in 1871.

It is rash indeed to prophesy in industrial matters, which are influenced by many complex problems, but it would seem that the great change which is impending over Middlesborough is the adoption of a new process in steel making. To bring ore from Spain—the greater part of which is converted into slag, simply to encumber the ground; whilst a smaller percentage ultimately finds useful application—seems an artificial proceeding. At first it was forced upon English steel-makers, from the fact that our native ores, with few exceptions, are phosphoric and therefore unfit for the pneumatic process of steel-making. Later discoveries have removed this disability and by the basic process phosphorus can be eliminated, and good steel made. The Cleveland district is richer in iron ore of high quality than any other in England, but this ore is not suitable for steel-making by the old acid process. It is therefore the manifest duty of Cleveland to foster and perfect the basic system of steel-making, and so use the phosphoric ores of her native hills. The problem is chiefly a commercial one. Happily the stagnation of trade will quicken the ingenuity and enterprise of steel-makers, and we shall no longer depend so fully on a foreign source for the raw material of the most important industry in the kingdom.

The discussion on Mr. Head's paper turned chiefly on the respective merits of Yorkshire iron and mild steel. Mr. Windsor Richards said that best Yorkshire iron was better than the best mild steel made. The statement is too sweeping, and those who use this material will be more likely to agree with Dr. White, the Director of Naval Construction, who spoke in praise of mild steel, laying emphasis on the lower price it costs compared to Yorkshire iron. Mr. Aspinall, the chief Locomotive Engineer to the Sheffield, Manchester, and Lincoln Railway, and one of the best mechanical engineers in the country, also spoke strongly in favour of steel, traversing Mr. Windsor Richards's statement that the mildest descriptions could not be case-hardened. The subject, however, is somewhat antiquated, and were it not for the high authority of Mr. Windsor Richards, would hardly be worth reopening. The difficulties that stood in the way of steel for engineering purposes have been overcome years ago.

The next paper on the list was a contribution by Mr. Richard Grigg, and dealt with the newest industry of Middlesborough, namely, that of salt manufacture. The late John Vaughan, boring for water, came upon salt, and the result has been that quite a brisk industry has sprung up. At first the wells were made by the diamond drill, but the process was so expensive that the industry would have been strangled in its birth, had it not been that American ingenuity came to its aid. The salt in the Middlesborough district is at a considerable depth below the surface; in some places 1700 feet. The strata that have to be bored through are difficult, and it was thought at one time that the salt was too deep to win with profit. Some shrewd person, who had travelled in Pennsylvania, remembered how the Americans make their oil wells, and the system has been transplanted to Middlesborough, so that in some parts one might also fancy one's self in the neighbourhood of Pittsburg, so closely have the characteristic timber derricks been copied in this heart of the iron country. The chief point of interest raised by Mr. Griggs's paper was whether the brine-pumping is going to lead to subsidence or not. On the other side of our island, in the salt districts of Cheshire, brine-pumping has led to most curious and, to those on the surface, unpleasant results. The houses in Northwich bear evidence of this; the house-line presents most devious and irregular courses; the houses themselves are iron strapped or wooden bound, so that they may be "jacked" to lift them, as the earth upon which they stand subsides, and it is no uncommon thing for a Northwich landlord to be called on to the rescue of his buildings, which are in process of disappearing beneath the surface. In one place a house has so far settled down that what was the first-floor bed-room has become the basement, and the front door has been cut off between the two upstairs bed-room windows. Northwich Bridge has been lifted several times, or it would have been transformed into a dam; whilst large tracts of land have subsided bodily, and in one place there is, or used shortly ago to be, a line of rails which ended abruptly at the edge of a cliff, the remaining part being on a plain beneath. At one time these rails were continuous, and were only broken through subsidence caused by the abstraction of salt beneath. Probably, however, Middlesborough will not be served in this way. The salt there is deeper, and is surmounted by a stratum of rock. As the brine-pumping goes on, and large cavities are formed by the abstraction of salt, the roof of rock is left unsupported. The superincumbent mass of earth may, or may not, break this down. It is hoped that should a fall of the rock take place, the pieces descending will form themselves into a dome shape, and, therefore, be well calculated to resist the weight above. The hope appears too sanguine, for the rock would be more likely to give way over the centre of the cavity than at the sides, where it is nearer the supporting salt not dissolved; indeed, the dome would more likely be an inverted one. In the Cheshire district we believe the subsidences have invariably been of a gradual nature, so that inconvenience rather than danger has been the result. In Middlesborough the results may not be of the same gentle kind. It is true that the cavities are deeper in the earth, and that is an element of safety in one respect, but should the stratum of rock below give way suddenly serious results might follow, especially if some of Middlesborough's ponderous furnaces were above the spot affected. Near Nancy, in France, a subsidence of earth took place which was so sudden that it caused a report which was heard 12 miles away. Middlesborough is pumping salt close to the town, and what is, of course, worse, in the near neighbourhood of the docks. Authorities, however, differ as to what will be the result; time alone will prove; it may be in a manner more convincing than pleasant. Mr. Griggs's paper contains an excellent description of the machinery used, and illustrations of the same were exhibited on the walls of the Town Hall, where the meeting was held.

A paper by Mr. A. L. Steavenson, entitled, "Description of the Electric Rock-Drilling Machinery at the Carlin How Ironstone Mines in Cleveland," was next read. After briefly referring to the various means of drilling holes for blasting purposes, the author proceeded to describe the electric drill. We could not give a description of this without the illustrations which were exhibited on the walls. Mr. Steavenson, who is a mining engineer, has tried all kinds of drilling—hand, compressed air, hydraulic, and petroleum engine, but he gives preference to electricity as a means for transmission of power in this work, although he says that petroleum engines have done good work.

The last paper read at the meeting was a contribution by Mr. George J. Clarke, engineer to the Tees Conservancy. In this he describes briefly some of the works which have been done in making the harbour at Teesmouth and improving the navigation. Dredgers, training-walls, and breakwaters have been combined in this work which has proved of such signal value to the district; in fact they have made its large commerce possible.

During the meeting a number of excursions to various iron-works were made, and members had an opportunity of seeing the colossal proportions to which the machinery for the production of iron and steel has been carried in the present day.

THE WILLIAMS COLLECTION OF MINERALS.

A FEW words relative to the collection of minerals which has just been distributed among various museums by Mr. J. C. Williams, M.P. for the Truro Division of Cornwall, will be of general interest. This collection had been gradually brought together by the father and grandfather of Mr. Williams; it was removed nearly thirty years ago from Scorrier, where Mr. Michael Williams formerly lived, to Caerhays Castle, nine miles from the nearest railway station (St. Austell), and it has since been too remote from the ordinary line of travel to be of easy access to visitors. It was in this collection, while it was still at Scorrier, that my predecessor, Prof. Maskelyne, F.R.S., noticed in 1863 the specimen of connellite from which it seemed to him

that the first crystallographic measurements might be obtained: the specimen was presented by Mr. Michael Williams to Mr. Maskelyne for the British Museum, and has ever since been on exhibition in the Gallery. As the crystals were only $\frac{2}{100}$th of an inch in thickness, the determination of their form was a noteworthy piece of scientific work; and it may be observed that the more recent discovery of larger crystals of the same beautiful mineral in another Cornish locality has only served to confirm the remarkable accuracy with which the form of those acicular crystals was then determined.

A short time ago, Mr. J. C. Williams, whose open-handed generosity is well known in Cornwall, perceiving that the continuance of the collection in so isolated a museum as that of Caerhays Castle prevented its utility both to students and the general public, decided to select some of the specimens for preservation in the family, and to present the remainder to public museums. Accordingly, in a courteous letter, he invited me to Caerhays to select any specimens which would be useful in completing the series preserved in the British Museum, and I immediately went down, accompanied by my colleague Mr. Miers, to examine the collection and remove the specimens which should be selected.

The collection, which amounted to about 10,000 specimens, was exhibited in numerous glazed wall-cases and table-cases in a large hall well lighted from the roof. The specimens were from various parts of the world, but as a rule only those of local origin could be of service for an old-established collection like that of London: the Cornish specimens, however, formed a series which, owing to the closing of so many mines and the change of mineral conditions in others, it would be quite impossible to reproduce in the present day: for the acquisition of such specimens the successive owners of the collection, by reason of their interest in Cornish mining enterprise and its products, have had excellent opportunities of which they have not failed to make use. In all, nearly 300 specimens were reserved by Mr. Williams for continued preservation at Caerhays; 510 specimens have been selected for the British Museum; the collection formed by the late Mr. John Taylor (to whom the British Museum was indebted for the donation of some excellent mineral specimens), and acquired at his decease by Mr. Michael Williams, has been given, with the exhibition-cases containing it, to the Camborne Museum; the remaining specimens and exhibition-cases have been divided between the museums of Redruth and Truro.

That the character and extent of the donation to the British Museum may be more readily appreciated by visitors, the selected specimens have been arranged in four window-cases of the Mineral Gallery, and will be exhibited together for a year or two before their distribution through the main collection. Special attention may be directed to two specimens of blende (sulphide of zinc) which for size and excellence are superior to any yet heard of, and in colour somewhat resemble those from Hungary. A remarkable specimen presenting crystals which are of an emerald-green colour and of unusual form, has been examined by Mr. Miers in conjunction with Mr. Prior, and will shortly be described by the former. He finds the crystals to be identical with spangolite (sulphate and chloride of copper and aluminium); of this species, described by Mr. Penfield three years ago, only one other specimen, found and preserved in the United States, is known to exist. There is a fine suite of crystallised specimens of cassiterite (oxide of tin). Special mention, too, should be made of the specimens of redruthite (sulphide of copper), the large series of specimens of chalcophyllite, clinoclase, and olivenite (arsenates of copper), libethenite (phosphate of copper), liroconite (phosphate of copper and aluminium), cupro-uranite (phosphate of copper and uranium), pyromorphite (phosphate and chloride of lead), cerussite (carbonate of lead), chalybite (carbonate of iron), and fluor.

The thanks of Cornish and London students are due to Mr. J. C. Williams for the generosity and self-denial he has shown in parting for their benefit with a valuable collection formed by the efforts of at least two preceding generations of his family.

L. FLETCHER.

PROPOSED NEW TELESCOPE FOR CAMBRIDGE OBSERVATORY.

IN order to complete the equipment of the Cambridge Observatory a public appeal has been made for funds. The appeal reads as follows:—

"It will be allowed that the Cambridge Observatory ought to be completely equipped for carrying on the most advanced work in modern astronomy. As celestial photography is the branch of astronomy in which the most important advance is now being made, it has been decided that a photographic telescope shall be obtained if the necessary funds be forthcoming. It is the opinion of those most competent to form a judgment that a photographic refractor of about 18 inches diameter would render it possible to attain results of the highest excellence. The new objective would be corrected for the photographic rays, and the present Northumberland telescope would serve as the guide when attached to the new tube. With such an exceptionally efficient instrument the director of the observatory would devote the attention of the staff (presently to be liberated by the termination of the international zone work on which it has been engaged for many years) to the investigation of stellar parallax. At the same time the telescope would be admirably adapted for other work. The twin instrument would be erected in the building at present occupied by the Northumberland equatorial, but a new dome, mounting, and driving clock would be required.

"The scheme sketched above has received the general sanction of the senate of the university, and the observatory syndicate are authorised to take the preliminary steps necessary to carry it out.

"The estimated cost for the new objective with the mounting, driving gear, and other adjuncts, is £2450. To this must be added £500 for the new dome, while the apparatus for measuring the photographs would cost £150. With the moderate allowance of £100 for extras, the total sum wanted is found to be £3200. The observatory syndicate have had under their consideration the means of providing this sum. There is a 'Special Sheepshanks Fund' available for the purchase of astronomical instruments for the Cambridge Observatory. This fund amounts at present to about £1500, of which about £1000 might be prudently expended. Accordingly about one-third of the money now required could be taken from the special Sheepshanks fund, whilst the remaining two-thirds would have to be raised otherwise. As the state of the university finances renders it hopeless to expect that any large sum could be forthcoming for this purpose from the university chest, it only remains to make an appeal to the public. The syndicate would therefore urge the friends of the University of Cambridge, and those interested in astronomical science, to render substantial aid in the furtherance of this project. They accordingly ask for donations towards the sum of £2200 which they have shown to be requisite for the full efficiency of the Cambridge Observatory.

Subscriptions will be received by Sir Robert Ball or by any of the following members of the observatory syndicate:—John Peile (vice-chancellor), G. G. Stokes, G. D. Liveing, G. H. Darwin, H. M. Taylor, and W. W. Rouse Ball. A list of subscriptions will be duly announced after replies to the appeal have been received.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE University Extension movement has hitherto received no assistance in the form of grants from the Government. But now that the movement is recognised as an educational power in the land it should be subsidised to a certain extent. As Prof. Stewart remarked in the course of a speech on the subject, delivered in connection with the summer meeting at Cambridge, "There was no sum of money that could be better spent by the State for educational purposes than a grant, say of £5,000 a year, to the university extension movement, because thereby they would render the £6,000,000 a year paid for elementary education so much more effective and productive, seeing that a very large proportion of university extension students were elementary school teachers." It was afterwards resolved: "That, in the opinion of this conference of university extension students, application should be made as early as possible to the Education Department for aid to university extension work, particularly for subjects not dealt with by the Technical Instruction Act."

UPRIGHT PENMANSHIP is rapidly becoming popular with the teachers and pupils in our schools, if we are to judge from the yearly growth in the number who send in copybooks to Mr. J. Jackson's annual competitions. The prize-list for 1893 just received contains four photographed specimens of prize-

writing, and informs us that 1441 copybooks were sent in (as against 1121 in 1892). An eighth competition is announced for June 1894, when prizes to the amount of £60 will be awarded.

THE following is a complete list of the candidates to whom the University of London has awarded the degree of Doctor of Science this year:—Experimental Physics: Robert Wallace Stewart; Chemistry: Fredk. Daniel Chattaway and John Theodore Hewitt; Zoology: Henry Bargman Pollard; Animal Physiology: John William Pickering; Geology and Physical Geography: John Walter Gregory, William Fraser Hume, Maria Matilda Ogilvie.

SCIENTIFIC SERIALS.

Bulletin of the New York Mathematical Society, Vol. ii. No. 10. July 1893 (New York: Macmillan).—This young mathematical society crowns the previous good work of its *Bulletin*, in this, the concluding number of its second volume, by the translation and publication of Dr. Felix Klein's "programme on entering the philosophical faculty, and the senate of the University of Erlangen in 1872." It is entitled "A comparative review of recent researches in geometry" (pp. 215–249). The author prefixes a note in which he states that the programme had a limited circulation at first, with which he was then fairly well satisfied, but now that Lie's "Theorie der Transformations gruppen" has appeared, and that an Italian translation has been published in the *Annali di Matematica*, it seems proper that a wider circulation should be given to his expositions. The translation, which is a literal one, has been admirably done by Dr. M. W. Haskell, and we feel sure that its publication will greatly extend Dr. Klein's *clientèle*. A few additional footnotes are supplied here and there. Dr. F. N. Cole continues his previous work with an article on "the transitive substitution-groups of nine letters" (pp. 250–258). He points out that Mr. Askwith (*Quar. Jour. of Mathematics*, vol. xxvi.) gives only 22 of the 34 actually existing types, and discusses the complete list of the transitive groups of this degree, with brief explanations of the processes by which he has obtained them. Prof. Ziwet gives a brief analysis (pp. 258, 9) of the "Index du répertoire bibliographique du Sciences Mathématiques, publié par la Commission permanente du répertoire" (Paris, 1893). Notes, lists of new publications, and the index complete the number.

IN the *Botanical Gazette* for July, Mr. D. M. Mottier has a paper on the embryo-sac and embryo of *Senecio aureus;* his results agree closely with those of Strasburger on *S. vulgaris;* Mr. P. Dietel describes a number of new specimens of Uredineæ and Ustilagineæ; Mr. G. F. Atkinson completes his account of the biology of the organism which causes tubercles in the roots of Leguminosæ; and Mr. C. Robertson contributes another to his series of articles on flowers and insects.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 15.—"On the Annual and Semi-annual Seismic Periods." By Charles Davison, M.A., Mathematical Master at King Edward's High School, Birmingham. Communicated by Prof. J. H. Poynting, F.R.S.

Method of Investigation.—The method adopted is similar to that employed by Dr. C. G. Knott in his paper on "Earthquake Frequency."

If $f(\theta)$ be a periodic function of θ, then

$$f(\theta) = a_0 + a_1 \cos(\theta + \alpha_1) + a_2 \cos(2\theta + \alpha_2) + \ldots a_n \cos(n\theta + \alpha_n) + \ldots,$$

from which it follows that

$$\frac{1}{\pi}\int_{\theta-\pi/2}^{\theta+\pi/2} f(\theta)d\theta = a_0 + \frac{2a_1}{\pi}\cos(\theta + \alpha_1) - \frac{2a_3}{3\pi}\cos(3\theta + \alpha_3) + \ldots + \frac{2a_n \sin\frac{n\pi}{2}}{n\pi}\cos(n\theta + \alpha_n) + \ldots.$$

This latter expression gives the mean value of $f(\theta)$ through an interval $\pi/2$ on either side of θ. From it, all terms involving even multiples of θ are eliminated, and the coefficients of all terms after the second are diminished to a greater extent than that of the second.

A definition of the unit earthquake having been adopted, the earthquakes of different districts are classified in half-monthly groups, the first half of February containing fourteen days, and of all the other months fifteen days; and the numbers so obtained are reduced to intervals of equal length (fifteen days). The numbers for the two halves of each month are added together. The mean of the numbers for the six months from November to April gives the six-monthly mean corresponding to the end of January. Six-monthly means are calculated in this way for the end of each month; each mean is divided by the average of all twelve, and the difference between each quotient and unity is multiplied by the augmenting factor 1·589, in order to obtain the correct value of the ratio $a_1 : a_0$. The curve obtained by plotting these reduced means thus gives special prominence to the annual period, by eliminating the semi-annual period and all those which are fractions of six months, and by diminishing the amplitudes of all other periods with respect to that of the annual period.

In investigating the semi-annual period, the numbers corresponding to the first halves of January and July are added together, and so on; the rest of the method being the same as for the annual period. The result gives special prominence to the semi-annual period by eliminating the annual period, and by eliminating or diminishing the amplitudes of all periods less than six months.

Seismic Periodicity in relation to Intensity.—This discussion is founded on: (1) lists compiled from Mallet's great catalogue, first, of shocks which were so slight as to be just perceptible, and, secondly, of those which were strong enough to damage buildings; (2) Prof. Milne's classification of the Japanese earthquakes of 1885 to 1889 according to the areas disturbed by them; and (3) different catalogues relating to the same district, it being obvious that two such catalogues for the same time can only differ by the omission or inclusion of slight shocks.

The following results are obtained:—(1) In both periods, the amplitude is greater for slight than for strong shocks; (2) there appear to be two classes of slight shocks with an annual period, the stronger having their maximum in winter, the weaker in summer; and (3) in the case of the semi-annual period, both strong and slight shocks, as a rule, have nearly the same maximum epochs.

Seismic Periodicity in relation to Geographical Position.—The number of records examined is 62, 45 belonging to the northern hemisphere, 14 to the southern, and 3 to equatorial countries.

1. *Annual Period.*—In every district, and in all but five records (which are obviously incomplete), there is a fairly well-marked annual period. As a rule, different records for the same district agree in giving the same, or nearly the same, maximun epoch. Excluding, however, those which disagree in this respect, we have left 34 records for the northern hemisphere, 9 for the southern, and 2 for equatorial countries. In the northern hemisphere, 4 records give the maximum in November, 16 in December, and 6 in January; in the southern hemisphere, 2 in April, 2 in May, 3 in July, and 2 in August; the end of the month being supposed in each case. As a rule, then, the maximum epoch occurs in winter in both hemispheres. The amplitude of the annual period ranges from 0·05 (New Zealand) to 0·67 (Sicily and Algeria), the average of 57 records being 0·33.

2. *Semi-Annual Period.*—Of the 62 records examined, only 3 fail to show a semi-annual period, the cause of the failure in these cases being no doubt the imperfection of the seismic record. In New Zealand and South-east Australia, the maximum epoch generally falls either in February or March and August or September; in North America, as a rule, in March or April and September or October. But for other regions it does not seem possible as yet to deduce any law. The amplitudes of the semi-annual period ranges from 0·06 (southern hemisphere) to 0·79 (Mexico), the average value being 0·24.

3. In fifteen cases, the amplitude of the semi-annual period exceeds that of the annual period. Eleven of these records include the following insular districts, which are among the most well-marked seismic regions in the world, namely, the Grecian Archipelago, Japan, the Malay Archipelago, New Zealand, and the West Indies. The average amplitude of the annual period in these eleven cases is 0·16, and that of the semi-annual period 0·24; *i.e.* the average amplitude of the annual period is just half that for all the districts examined, while in the case of the semi-annual period the average amplitudes are the same.

Origin of the Annual Period.—In this, the concluding, section

of the paper, an attempt is made to show that the annual change in barometric pressure may be the cause of the annual change in seismic frequency. It would be difficult to prove that such a connection exists, but reasons are given which seem to render it in some degree probable.

1. The most probable cause of the origin of the majority of non-volcanic earthquakes is the impulsive friction, due to slipping, of the two rock-surfaces of a fault. Now, whatever be the causes of seismic periodicity, it seems probable that they are merely auxiliary, and determine the epoch when an earthquake shall take place, rather than there shall be an earthquake at all. Prof. G. H. Darwin has shown that the vertical displacement of the earth's surface by parallel waves of barometric elevation and depression is not inconsiderable, and that it diminishes at first very slowly as the depth increases. Since the fault-slip which produces even a moderately strong shock must be very small, and since the work to be done in such a case is, not the compression of solid rock, but the slight depression of a fractured mass whose support is nearly, but not quite, withdrawn, the annual range of barometric pressure does not seem incompetent to produce the effects observed.

2. Comparisons between the dates of the maximum epochs of the seismic and barometric annual periods are made in 31 of the districts treated in this paper. The seismic maximum approximately coincides with the barometric maximum in 10 districts, and follows it by about one month in 9, and by about two months in 4, districts; the other cases generally admitting of some explanation.

3. In several insular seismic districts, and especially in Japan and New Zealand, the amplitude of the annual period is very small; and, if many of the earthquakes of these districts originate beneath the sea, this should be the case; for, in the course of a year, as the barometric pressure changes, the sea will have time to take up its equilibrium position, and thus the total pressure on the sea-bottom will be unaltered.

PARIS.

Academy of Sciences, July 31.—M. de Lacaze-Duthiers in the chair.—Note on the work of M. D. Colladon, by M. Sarrau. M. J. D. Colladon, who died at Geneva on June 30, at the age of 91, was the first to transmit power to a distance by compressed air, and to utilise this power in boring tunnels. His system, proposed in 1852, was adopted in the working of the Cenis and Gothard tunnels. His name is also widely known in connection with improvements in paddle-wheels, and his celebrated investigation of the velocity of sound in the Lake of Geneva, in connection with Sturm.—Petroleum beds near Pechelbronn (Lower Alsace); exceptionally high temperatures observed there, by M. Daubrée. About twelve years ago the flooding of one of the petroleum mines of Pechelbronn by a sudden outbreak of the mineral oil suggested a substitution of boring and pumping for the laborious subterranean process, with the result that the yield was increased more than seventy times. The tertiary beds, which have an inclination of 7 or 8 per 100, are rich in gas, and the force with which the jets are projected when struck is sufficient to drench the men and produce a disturbance resembling an earthquake. It is calculated that all the sources together produce at present 80,000 kgr. of petroleum per day, and it is probable that many jets, if bored wide enough, would be capable of yielding 50,000 kgr. per day each. Some of the sources show a remarkable rise of temperature with increasing depth, reaching 1° for 7m. in one boring. This rise, contrary to the usual experience, becomes more rapid as the depth increases. M. Daubrée attributes both the occurrence of the oil and the extraordinary distribution of temperature to a particularly energetic internal activity, chemical or otherwise, of the globe at that point.—On the unequal resistance to drought exhibited by some largely cultivated plants, by M. P. P. Dehérain.—Observation of four simultaneous water-spouts at Antibes, by M. Naudin. These were observed on July 27, on the sea between Nice and Antibes. They were ranged very nearly in a straight line running east and west. The wind had suddenly veered from west to east and the water-spouts were produced at the junction of the two air-currents, and were observed to turn in a direction contrary to the hands of a watch. They lasted several minutes, gradually approaching the land, and broke on the hills near the shore.—Photography and physical observation of comet *b* 1893, made at the Juvisy Observatory, by M. F. Quénisset. A photograph was obtained by means of a Hermagis lens of 16 cm. aperture, the exposure being 40m., on July 19. The negative shows a double tail, one of them 1° long and pointing east, the other 30′ long and inclined towards the north.—An addition to the nomographic method recently described, allowing the introduction of another variable, by M. Maurice d'Ocagne.—On benzoylnicotine, by M. A. Étard.—On the fixation of iodine by starch, by M. G. Rouvier.—On the preparation of caproic and normal hexylic acids, by M. J. Tripier.—On gallate of mercury, a new antisyphilitic preparation, by MM. Brousse and Gay.—On virulent and epidemic cholera, by M. N. Gamaleia. The concentration of the nutrient medium, and the abundance of saline matter in the culture fluid gives rise to several slightly different variations of the cholera vibrio, which agree in being very much more virulent than the ordinary type. The author suspects an analogy between this fact and the observed dependance of the epidemic upon the conditions of desiccation of the soil and the level of subterranean waters.—On submarine photography, by M. Louis Boutan.—On the habits of *Blennius sphinx* and *Blennius montagui*, Fleming, by M. Frédéric Guitel.—On the cerebral nuclei of the myriapods, by M. Joannes Chatin.—Researches on the anatomy and development of the male genital apparatus of the orthopterous insects, by M. A. Peytoureau.—Anatomical characters of the stems of the Dioscoreæ, by M. C. Queva.—Development of the ground-nut, by M. A. Andouard.—On a trial of a screw for vertical propulsion, by M. Mallet. A Langlois air propeller of 2·5 m. diameter was attached to the car of a balloon of 800 m^3. capacity, and worked by the muscular power of the aeronauts. During one minute the balloon was raised 100 m., sinking again to its former level on stopping the propeller.

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